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MARKET ANALYSIS AND CONSUMER IMPACTS SOURCE DOCUMENT

Part III Consumer Behavior and Attitudes Toward Fuel Efficient Vehicles

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U.S. DEPARTMENT OF TRANSPORTATION
Research and Special Programs Administration
Transportation Systems Center
Cambridge MA 02142

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FINAL REPORT

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16. Abstract

This source document on motor vehicle market analysis and consumer impacts consists of three parts. Part I is an integrated overview of the motor vehicle market in the late 1970's, with sections on the structure of the market, motor vehicle trends, consumer trends, and market outlook. Part II consists of studies and reviews on: motor vehicle sales trends; motor vehicle fleet life and fleet composition; car buying patterns of the business market; impact of downsizing on automotive preference of new car buyers; demand for light trucks, recreational vehicles, used cars, and station wagons; and consumer expenditures for private motor vehicle transportation. Part III consists of studies and reviews on: consumer awareness of fuel efficiency issues; consumer acceptance of fuel efficient vehicles; car size choices; passenger car choices; truck choices; and motor vehicle usage trends.

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PREFACE

This report, DOT-TSC-NHTSA-80-2.III "Market Analysis and Consumer Impacts Source Document," summarizes the studies and reviews on the motor vehicle market of the 1970's which TSC has performed during the past two years as part of its support to the NHTSA Automotive Fuel Economy Program.

The source document is presented in three parts. Part I is an integrated overview of the motor vehicle market in the late 1970's. Part II is a series of reviews of the motor vehicle market and consumer expenditures on motor vehicle transportation. Part III is a review of behavioral and attitudinal studies on the consumers of motor vehicle transportation.

This document is deliverable under PPA HS-163, "Support for Research and Analysis in Auto Fuel Economy and Related Areas."

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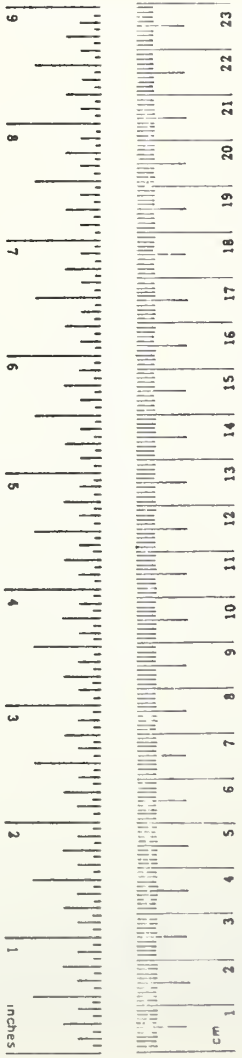
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

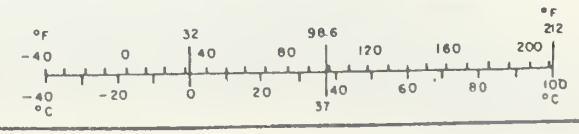
Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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MAJOR FINDINGS

o Consumers were somewhat skeptical about the existence of a present-day (1978) energy crisis. There seemed to be little sense of urgency and little willingness to make personal sacrifices for the purpose of energy conservation.

o At the time of data collection (1978), the public's awareness of fuel economy standards was not very extensive, and they were frequently confused with other government-sponsored fuel related activities.

o There exists strong correlation between the following owner demographic and vehicle characteristics: older owners prefer heavier vehicles; younger owners prefer smaller vehicles; among passenger cars, women prefer compacts, sporty coupes, and specialty coupes, whereas men show a preference for full-sized and luxury cars; rural owners own a higher proportion of light trucks; and city dwellers own a higher proportion of sedans.

o Unlike one-vehicle households, two-vehicle households have the opportunity to functionally specialize their holdings. These households may choose a vehicle pair where neither vehicle alone fully meets travel needs, but the combination of vehicles effectively serves the household's purposes. Empirical work has shown that the larger vehicle in the most preferred pair is smaller than the most preferred vehicle in a one-vehicle household.

o The vehicle attributes most desired by consumers are: fuel economy, reliability, and seating and luggage capacity.

o Overall, consumers prefer a mid-sized automobile.

o The sharp growth in total motor vehicle ownership during the 1970's was primarily due to an increased number of multi-vehicle households.

o During the 1970's, many more people entered the light truck market with personal transportation as their primary motive.

1. INTRODUCTION

Part III of this source document is an integrated view of: consumer awareness of fuel efficiency issues; consumer attitudes toward fuel efficiency issues; factors that influence vehicle-type choices; attributes that consumers desire in motor vehicles; and the major motor vehicle ownership trends of the 1970's.

Part III is primarily based on studies and reviews contracted for by NHTSA. These contractors included National Analysts (DOT-HS-7-01782), Charles River Associates (DOT-HS-7-01779), Market Facts (DOT-HS-7-01781), and Cambridge Systematics, Inc. (DOT-HS-7-01780). In addition, this document utilizes data from Newsweek and Rogers National Research, Inc. Most of the data collections for these contracts were performed between 1976-1978. Hence, they may report findings that have become anachronistic to some extent.

2. SOURCES AND THEIR METHODOLOGIES

This section discusses the major data and analysis sources for this source document and reviews the methodologies that underlie these studies.

2.1 GROUP DEPTH INTERVIEWS (NATIONAL ANALYSTS)

National Analysts, under contract DOT-HS-7-01782, prepared the report Consumer Behavior Toward Fuel-Efficient Vehicles: Second Cycle in July 1979 for the National Highway Traffic Safety Administration (NHTSA). The research was based on a series of 33 "group depth interviews" in seven U.S. cities during August and September, 1978. The seven cities were selected to provide a broad range of driving terrains, climactic conditions, and vehicle purchase patterns. Table 2-1 shows the distribution of groups among sites.

In this series of structured conversations with recent vehicle purchasers around the country, National Analysts staff members probed consumers' attitudes toward energy conservation, the uses to which they put their cars and light trucks, and their reactions to some of the vehicle design changes that are likely under the federal mandate to manufacturers to build progressively more fuel efficient vehicles over the next five years.

The group depth interview technique brought together eight or nine consumers and a professional moderator experienced in group dynamics and interviewing skills. For about two hours, the participants discussed a topic, sometimes expressing their own views, sometimes reacting to the views of others in the group. The moderator did not participate in the discussion except to start the group off, guide it through relevant topics, draw out reticent participants, and follow up or probe in areas where new insights or information emerged.

TABLE 2-1. DESCRIPTION OF GROUP DEPTH INTERVIEW COMPOSITIONS AND LOCATIONS: NATIONAL ANALYSTS

	Philadelphia, PA	Crofton, MD	Moline, IL	Tampa, FL	Phoenix, AZ	Spokane, WA/ Coeur D' Alene, ID	Total
Passenger Cars							
Luxury cars	X				X		2
Full-size cars			X		X	X	3
Intermediates		X		X		X	3
Compact cars		X	X		X		3
Subcompact cars		X	X		X		3
Station wagons				X		X	2
Light Trucks							
Pickups, first purchase		X		X			2
Pickups, half ton, personal		X		X			2
Pickups, over half ton, personal	X			X		X	3
Pickups, half ton, commercial		X			X		2
Pickups, over half ton, commercial					X	X	2
Four-wheel-drive vehicles	X						1
Window vans		X		X			2
Camper vans		X					1
Solid-side vans, personal		X					1
Solid-side vans, commercial	X						1
TOTAL	4	9	3	6	6	5	33

Toward the end of each group depth interview, the moderator presented a series of "tradeoffs" to participants. These were a series of strategies which a manufacturer could use to raise its overall fleet fuel economy; any or all might be used. They are called tradeoffs because participants were asked to trade them off against each other by ranking them. While the tradeoffs presented occasionally varied from group to group, they generally included downsizing, weight reduction through the use of more expensive, lightweight materials, use of smaller, less powerful engines, use of diesel or turbocharged gas engines, and additional gearing in the powertrain.

The strength of the group depth interview technique rests in its ability to elicit complex attitudes, perceptions, and opinions. It permits deeper probing than would be possible in an ordinary sample survey, and allows for challenge, defense, and retreat to reveal deeply-held positions as part of the group discussion process. Unfortunately, the National Analysts results have some limitations.

First and foremost, it must be remembered that these group depth interviews were conducted in late 1978, and because of events since then (Iranian Revolution, gas lines in U.S., large OPEC price increases in 1979, et al.) the viewpoints reported may to some extent already be anachronistic.

Second, neither the locations in which group depth interviews were held, nor the people who participated in them, were selected randomly. Without random selection and with the relatively small sample size, statistical generalization is inappropriate. Specifically, there was a priori separation of consumers into groups such as "luxury car owners" or "light truck owners." In other words, light truck owners were queried as to their sentiments toward light trucks. This nearly exclusively male "light truck owners" group certainly produced different responses than if more women had been included in the light truck group depth interviews.

These limitations are more critical when there is dissension on some view than when there is agreement, for the same reason that a close election is harder to call than a landslide. This suggests that, while it is not possible to project the opinions expressed by respondents with any degree of statistical confidence, viewpoints and perceptions that are widely held within a group, and even more so across groups, deserve practical conviction that they reflect an important segment of the vehicle buying population. The results should not be considered as measuring the prevalence of the data without further quantitative research. Instead, the results should be understood as discovering hypotheses and providing insights into the phenomenology of the motor vehicle consumer.

2.2 FOCUS GROUPS (CHARLES RIVER ASSOCIATES)

Charles River Associates (CRA), under contract DOT-HS-7-01779, prepared the report Consumer Behavior Towards Fuel Efficient Vehicles in April, 1979 for NHTSA. The research was based on a series of 20 "focus group" interview sessions in four metropolitan areas during the winter and spring of 1978. Table 2-2 summarizes the composition of the 20 groups.

The CRA focus group interview technique was virtually identical to National Analysts' group depth interview technique. Thus, a description of it will not be repeated.

The limitations of the focus group, or group depth interview, technique, as discussed in the previous section, apply as well to the CRA research and will not be repeated. However, it is worthwhile to repeat and emphasize that the research was conducted in early 1978 and may report findings that have become outdated.

2.3 FOCUS GROUPS AND CONSUMER EXPERIMENTS (MARKET FACTS)

Market Facts, Inc., under contract DOT-HS-7-01781, prepared the report A Study of Consumer Behavior Towards Fuel Efficient Vehicles in June, 1979. The composition of the focus groups

TABLE 2-2. COMPOSITION OF FOCUS GROUPS: CHARLES RIVER ASSOCIATES

	Atlanta	
Sex	Age	Vehicle-Type
Women	18-35	Mid-sized Car
Men	36-55	Full-sized Car
Men	18-35	Compact Car
Men	25-50	Mid-sized Specialty Car
Women and Men	25-50	Light Trucks: 1/2, 3/4, and 1 ton Pickups
	Chicago	
Sex	Age	Vehicle-Type
Women	36-55	Compact Car
Men	18-35	Mid-sized Car
Men	36-50	Subcompact Imported Car
Men	25-50	Luxury Car
Women and Men	25-50	Light Trucks: Compact Imported Pickups
	Boston	
Sex	Age	Vehicle-Type
Women	36-55	Full-sized Car
Men	18-35	Full-sized Car
Men	36-55	Compact Car
Men	18-35	Subcompact Car
Women and Men	25-50	Light Trucks: 1/2, 3/4, and 1 ton Pickups
	San Francisco	
Sex	Age	Vehicle-Types
Women	18-35	Subcompact Car
Men	36-55	Mid-sized Car
Men	25-50	Subcompact and Compact Specialty Cars
Women	25-50	Full-sized Station Wagons
Women and Men	25-50	Light Trucks: Vans and Utility Vehicles

interviewed by Market Facts during November and December of 1978 is listed in Table 2-3.

The Market Facts focus group interview technique was very similar to that of National Analysts and Charles River Associates, and therefore, a description of it will not be repeated. The limitations of this technique, as discussed in Section 2.1, apply as well to the Market Facts focus group research and will not be repeated here. The reader should remember, however, that the research was conducted in late 1978 and may report antiquated opinions.

In addition to the focus group research, Market Facts conducted a series of "consumer experiments" during the same time period. These included a non-random sample survey and hypothetical trade-off tasks. In the survey, consumers indicated their level of concern for several issues (Sections 3.1.2-3.1.3). The trade-off tasks are discussed in Section 5.2.1.

2.4 NATIONAL TRANSPORTATION SURVEY (CAMBRIDGE SYSTEMATICS, INC./ WESTAT, INC.)

The National Transportation Survey (NTS) was administered to 1,095 U.S. households in May-June, 1978 by Westat, Inc. under contract to Cambridge Systematics, Inc. (CSI). CSI employed the results to evaluate present and expected future household preferences toward the automobile and other modes of transportation, to identify the factors that influence consumer choices as reflected by current motor vehicle ownership and alternatives to ownership, and to identify travel patterns of motor vehicles and other modes of transportation. CSI was under contract C-PRA77-16108 to the National Science Foundation to engage in this study.

The NTS survey instrument was comprised of three major blocks of questions. The first section, administered to a household head, concerned household-level data. Included here were an enumeration of the age, sex, primary activity, driver license status, and commuting mode (if applicable) of each household

TABLE 2-3. COMPOSITION OF FOCUS GROUPS: MARKET FACTS

Group	Location	Sex	Household Income	Vehicle Size
1	Boston	Men	Under $15,000	Small
2	Dallas	Men	Under $15,000	Large
3	Los Angeles	Men	$15,000 - $24,999	Small
4	Cedar Rapids	Men	$15,000 - $24,999	Large
5	Boise	Men	$25,000 +	Small
6	Cedar Rapids	Men	$25,000 +	Large
7	Los Angeles	Women	Under $15,000	Small
8	Boise	Women	Under $15,000	Large
9	Dallas	Women	$15,000 - $24,999	Small
10	Boston	Women	$15,000 - $24,999	Large
11	Dallas	Women	$25,000 +	Small
12	Chicago	Women	$25,000 +	Large

member, a complete inventory of the household's motor vehicle holdings, and a set of questions focusing on factors that influence motor vehicle ownership and travel decisions. The final two sections of the NTS survey dealt, in depth, with household travel behavior.

The NTS survey elicited direct statements of consumer preferences in some cases. In these situations, care must be taken in interpreting the results. Whereas empirical models designed to estimate consumers' revealed preferences inherently consider the joint influence of several factors on consumer choice, attempts to directly ascertain consumer preferences often fail to capture the true preference structure of individual consumers, since the questions do not force the respondent to tradeoff alternative vehicle attributes in expressing his or her preferences. To illustrate this point to the extreme, consider the case of a consumer choosing between two cars identical in every respect except for the ease of operating the trunk latch. If the consumer were asked to explain what was the most important feature dictating his or her ultimate choice, the response undoubtedly would be "ease of getting into the trunk." Missing from this response, of course, are all the other, more functional features, such as overall size, price, and fuel economy considerations which led the consumer to the final two choice alternatives.

A final caveat with regard to the NTS results is the time period during which the survey was conducted; the reader should remember that the reported findings are based on opinions expressed in the Spring of 1978.

2.5 VEHICLE-TYPE CHOICE ECONOMETRIC MODEL (Cambridge Systematics, Inc.)

The Cambridge Systematics, Inc. vehicle-type choice model, developed for NHTSA under contract DOT-HS-7-01780, assumes that the underlying choice behavior of one- and two-vehicle households differs. Separate models are formulated for one- and two-vehicle households, but no choice model is developed for households owning three

or more vehicles, or for fleet purchasers. Leased vehicles and vehicles other than model year 1967 are not included; the vehicle universe is specified as all vintage 1967-76 passenger auto and light trucks, both foreign and domestic. Each vehicle type is characterized as a distinct bundle of attributes.

The basic data source for this empirical research is the University of Michigan's Survey Research Center (SRC), Winter 1976 Survey of Consumer Sentiments involving approximately 1,200 households drawn from its rotating consumer panel. The method of multistage probability sampling is employed to select a random sample of households representative of all households in the contiguous United States.

The SRC data contain information on the make/model/vintage of all domestic vehicles, but only on the make/vintage of foreign vehicles. In addition, no data on vehicle options were collected. These data limitations forced CSI to characterize each make/model/vintage or make/vintage class of vehicle by the highest selling type in the class, which collapsed the vehicle-type universe from a potential of more than 2,000 down to about 600. Failure to incorporate vehicle option data may explain the negative coefficient on the acceleration variable that CSI obtains.

The model of vehicle-type choice assumes that the household is the relevant behavioral unit. The household makes its vehicle-type choices by evaluating the utility of various vehicle attributes conditioned on its demographics. The vehicle attributes CSI considers include:

Passenger Carrying Characteristics: CSI assumes this to be primarily measured by an "excess seats" variable, defined as the number of "adult equivalents"* composing the household. CSI presumes that the marginal utility of an additional seat should decrease with the seating capacity of the vehicle and increase

*The number seatable is defined in terms of a shoulder width of 25" per adult. A child below 16 years of age is considered .6 of an adult for seating purposes.

with the household size. CSI uses, therefore, a concave functional form for the utility of the "excess seats" variable.

Load-Carrying Capacities: CSI uses the cubic footage of covered trunk space to measure this attribute in cars, and vehicle-specific dummy variables to proxy for it in light trucks.

Performance Characteristics: CSI considers acceleration, turning radius, braking distance, interior noise level, and vehicle reliability as performance characteristics. This last attribute is assumed to be adequately represented by a vintage-specific scrappage rate.

Cost Characteristics: The model considers capital costs, operating costs, and transaction costs. CSI assumes that vehicle retail prices (list prices for new vehicles and retail market prices for used vehicles) represent the capital cost of ownership. Operating costs are presumed to be sufficiently represented by the proxy variable fuel costs per mile. Transaction costs are presumed to be incurred every time the household has a change in vehicle holdings. Since the costs associated with transacting a vehicle could not be directly estimated because of data insufficiencies, CSI obtained an estimate with a two-stage technique.* In the model specification, it is represented by a dummy variable which takes the value zero for vehicles currently owned by the household and one for all vehicles obtainable on the market.

Class and Style Characteristics: CSI uses a set of dummy variables to measure the effect of vehicle value of characteristics for which there exists no abstract representation. For example, a foreign car dummy is entered to capture any differences from domestic models beyond the quantifiable characteristics of passenger and luggage room, performance, and price.

*Specifically, given the other parameter estimates, the transaction dummy coefficient was estimated so as to equate the observed aggregate turnover rate with the turnofver rate the model predicted for the initial household sample.

The household's evaluation of the utility of these attributes is conditioned on three household demographic variables: household size, number of workers living in the household, and relative income of the household. CSI partitions these variables into five, three, and eight increments, respectively. Thus, there is segmentation of the total household sample into 120 possible cells.* CSI assumes that the data base (430 households in the one-vehicle model, 445 households in the two-vehicle model) is sufficient to support this degree of demographic differentiation. However, not all of the cells are necessarily filled by at least one household. For example, the probability that a household falls into the two-vehicle, highest income, no worker cell is only .00001309 [(.022)(.085)(.007)]. Thus, on average, only in a sample size of 76,394 (the inverse of .00001309) would one expect to find such a household.

The model treats expected vehicle usage as exogenous and assumes that the household evaluates vehicle utility dependent upon the vehicle attributes and household demographics discussed above. The utility function is assumed to be linear in vehicle and household attributes. Specifically, the one-vehicle-type choice model is a multinomial logit specification which assumes that at each point m, a household t selects that alternative j from the choice set C_{tm} which maximizes utility $U_{tjm} = Z_{tjm} \cdot \theta + \gamma \cdot X_{tjm} + \Sigma_{tjm}$. Here Z_{tjm} is a vector of functions of observed exogenous vehicle and household attributes; X_{tjm} is the transaction cost dummy variable; (θ,γ) is a parameter vector to be estimated; and Σ_{tjm} is an additive Weibull disturbance distributed independently and identically across decision-makers and alternatives. The two-vehicle-choice model attempts to capture the enhanced transportation availability and specialization of function afforded by two vehicles by specifying the utility of any vehicle pair to depend linearly on the characteristics of each vehicle separately

*120 is the product of (5)(3)(8).

and on the characteristics of a fictitious composite vehicle combining the best of both real vehicles.

The logit model specification implies that each demographically identical household, i.e., each cell, has identical tastes and hence identical probability distributions of vehicle holdings. The logit specification also assumes that, at the individual level, cross-elasticities of the choice probabilities are equal.

The Weibull disturbance term implies that although the disturbances are assumed to be distributed identically across vehicles of different vintages at any given decision point, households' vehicle choices are not independent across time: each period's choice depends on last period's holding in a recursive manner. This is what lends the model its "dynamic" nature.

The Weibull disturbance assumed by CSI also implies that the independence of irrelevant alternatives axiom holds. This axiom states that if alternative A is preferred to alternative B, and alternative B is preferred to alternative C, then, in the absence of alternative C, it must be true that alternative A is still preferred to alternative B.[1] This might appear to be intuitive, but it is actually a fairly strong behavioral assumption that may not hold when applied to aggregate behavior. For example, in the 1968 Presidential election, Nixon was shown to be preferred to Humphrey who was preferred to Wallace, but, in the absence of Wallace's candidacy, Humphrey would have been preferred to Nixon.*

Parameter estimates are obtained for the model with a "pseudo-maximum likelihood" technique, in that each household is treated as if it faced a choice set composed of its chosen alternative plus 25 other alternatives chosen at random from the vehicle universe of about 600 vehicle-types. This makes the model much more computationally tractable, but yields asymptotically inefficient estimates.

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*This is the classic counter-example to the axiom, and is based on opinion polls.

NOTE: Superscripts refer to references in Section 2.9.

2.6 VEHICLE-TYPE CHOICE ECONOMETRIC MODEL (WHARTON)

The Wharton Econometric Forecasting Associates (WEFA) model is a multi-equation stock-adjustment model. It is given little emphasis here because of intrinsic weaknesses in the model, among them its ignoring of light trucks and used cars as alternatives to new cars, its failure to recognize the household as the relevant economic unit, and its lack of a realistic supply-demand price determination (see Section 4.1.1.2).

2.7 MAIL SURVEY (NEWSWEEK)

The Newsweek survey of new car buyer opinions, based on a lengthy questionnaire mailed to approximately 10,000 new car buyers as identified by R.L. Polk Co., is tabulated annually. In 1979, roughly 40 percent of the new car buyers who were contacted completed and returned the questionnaire.

2.8 MAIL SURVEY (ROGERS NATIONAL RESEARCH, INC.)

Rogers annually develops new car and new light truck buyer profiles from a national probability mail sample which had 35,955 new car owner respondents and 8,491 new light truck owner respondents in 1979. Disaggregated data by make and model are proprietary.

2.9 REFERENCES FOR SECTION 2

1. James M. Henderson and Richard E. Quandt, Microeconomic Theory: A Mathematical Approach, (New York: McGraw-Hill), 1971, p. 285.

3. AWARENESS OF, AND ATTITUDES TOWARD, ENERGY-RELATED ISSUES AND FUEL EFFICIENT VEHICLES

The successful implementation of fuel economy standards is, among other factors, dependent on the level of consumer acceptance of cars and light trucks designed to meet these standards. In turn, consumer acceptance reflects underlying consumer attitudes toward fuel efficiency issues. This chapter reports findings about the public's perceptions of national energy problems, feelings about government intervention to implement a national energy policy, and attitudes toward currently owned and fuel efficient vehicles.

3.1 AWARENESS OF, AND ATTITUDES TOWARD, THE ENERGY CRISIS

3.1.1 Perceptions of an Energy Shortage[1,2]

Consumers in 1978 were somewhat divided and skeptical about the existence of a present-day energy crisis. There seemed to be little sense of urgency and little willingness to make personal sacrifices for the purpose of energy conservation. A recurrent belief was that current energy problems were the result of market manipulation by the oil companies, or a conspiracy between oil and auto companies, the Arabs, and the government. Proponents of this point of view said things like:

> "I think it's a plot between the oil people, the steel industry, and the auto industry."
>
> "As soon as the prices were jacked up, they brought ships in from offshore and said 'we have plenty of oil now.'"
>
> "I think it is just a way for the oil companies to make a lot of money, saying that we have an energy crisis."

Other people preferred to downgrade the crisis, mentioning advertising signs, lights in buildings at night, school busing, and "all those 747's circling around" as wasteful uses of energy which would not occur if the crisis were real.

Note: Superscripts refer to references in Section 3.4.

A subgenre of this disposition toward conspiracy theories is the widely held belief that technology exists which will remove the need to make sacrifices, but that this technology has been suppressed by greedy corporations. Typical was the story in group interviews about 70 miles per gallon carburetors whose patents have been bought up by oil companies. Another hardy perennial was the one about the customer who unsuspectingly buys a special experimental 100 mpg car, only to have it reclaimed by the manufacturer after a week or two.

Other consumers, who acknowledged temporary fuel shortages, nonetheless believed that new technologies will be developed which will make petroleum shortages irrelevant, and that these technologies will allow current lifestyles to persist. These people find no need for current conservation practices, preferring to remain optimistic about the power of "American ingenuity." Many in this group apparently believed:

> "If the time ever comes when we are running out [of petroleum supplies], I think they are going to invent something where you drop a pill in your gas tank with water and it will run your car."

Others expressed the belief that we should switch to more exotic technology, vaguely claiming that:

> "They are not using space age technology to handle this problem – they continue to rely on the same stupid combustion engine."

Despite persistent doubts about the existence of a short-term energy crisis, in the longer run there was widespread public acceptance of the view that world petroleum supplies are finite and that real shortages may face future generations. Ironically, those believers in a coming energy shortage described the undesirability of drastic actions. There was no sense of urgency, moderation is felt to be adequate:

> "We can't always spend, spend, spend and use, use, use. We do have to conserve, but moderately."

The synthesis of these varying opinions is an American public which needs to be convinced that the sacrifices which it is called on to make are actually needed, but, at the same time, a public which will likely respond positively to such an effort. People would like to believe that there is really no problem, either because there is plenty of undiscovered or withheld oil, or because school busing or auto racing or 747's circling O'Hare are the real drain on U.S. petroleum reserves. To believe these stories would justify continued extravagance; people clinging to them for that reason are potentially the most receptive audience for building widespread support of conservation measures.

National Analysts researchers indicated that the most powerful tool to achieve this end would involve symbolic acts by federal officials. Images of government officials in limousines cause many to question the primacy of petroleum conservation. Symbolic leadership from Washington in dramatizing the urgency of the fuel conservation issue is demanded.[3]

3.1.2 Perceptions of Gasoline Supply[4]

Consumers are fairly concerned about the general supply of gasoline. The Market Facts survey in late 1978 (before Spring, 1979 gas lines) found that 60 percent were "quite concerned," while only 11 percent were "not too concerned."

However, most respondents believe that the supply of fuel will be plentiful over the next few years; hence, concerns over the supply of gasoline are essentially longer-term. Many blame the Spring, 1979 gas lines on political crises in the Middle East. Although acknowledging that another Mid-East conflict could cause gas lines to recur, most people believed that this would not happen, or that such an occurrence would be short-lived. These opinions were voiced before the Shah of Iran abdicated and oil production was disrupted in late 1978 and early 1979.

3.1.3 Perceptions of Gasoline Prices[4]

There is generally a high degree of concern about gasoline prices. Eighty-four percent of the Market Facts sample were "quite concerned," and only five percent expressed "little concern."

Despite this high degree of uniformity, gas price increases seem to have a relatively small impact on driving patterns. Consumers cut back on other expenses to afford the gasoline for what they perceive as necessary driving requirements. Driving patterns are well integrated into higher level patterns of housing locations, metropolitan structure, and lifestyle decisions, and are relatively difficult to alter. In the longer run, current vehicles may be replaced by more fuel efficient vehicles. However, evidence indicates that in the absence of legislated fuel economy incentives, a dramatic increase in fuel prices would be required to shift a significant percentage of the population toward the purchase of more fuel efficient vehicles. With gas prices over a dollar a gallon and continually growing political discord in the Mid-East, this may already be happening as we move into the 1980's.

3.2 AWARENESS OF, AND ATTITUDES TOWARD, AUTOMOBILE FUEL ECONOMY STANDARDS

3.2.1 Awareness of Standards[2]

According to the Charles River study, the public's awareness of the fuel economy standards was not very extensive as of 1978, and they were frequently confused with other fuel related activities. Specifically, the demarcation between fuel economy standards and the EPA ratings was widely unknown. Regardless of specific knowledge of the fuel economy standards, most consumers were cognizant of the major trends in the automobile industry, i.e., downsizing and an across-the-board trend toward more fuel efficient vehicles.

3.2.2 Attitudes Toward Fuel Economy Standards[1]

The complexity of feelings about the energy crisis is matched by a plethora of reactions to the fuel economy standards. Overall support for the program is widespread and growing. It is usually lauded for being consumerist in intent: the government is finally going to do something about the high price of gasoline. Other consumers support the program because they perceive it as some sort of punishment levelled against the automakers and oil refiners for being so greedy as to have contrived the fuel shortage in the first place. Where this punitive intent is believed, it is applauded on the grounds that if left to their own devices (á la Adam Smith), the corporations would simply increase their rapacious exploitation of the public. Finally, a minority of support for the fuel economy standards comes from far-sighted consumers who understand that it is a necessity to conserve a finite resource.

It is interesting and fortunate that the need for government intervention is a thesis that flows logically from both the illogical conspiracy theory and the environmentalist conservation-of-an irreplaceable resource approach.

Opponents of federal action on fuel conservation either deny the need for such action because they deny the existence of an energy problem, or else support their position by appeals to the principles of free enterprise. These people conjure up the concept of laissez-faire capitalism to decry government impingement on the capitalist system.

Other opposition stems from the belief that federal government is incapable of efficiently managing such a program. The EPA fuel economy labeling program, eliciting widespread disbelief and irritation, is frequently cited as evidence. The general feeling seems to be that if the government issues such notoriously inaccurate fuel economy figures, what benefit could possibly come from any other government effort in the field of automotive fuel economy? The fine distinction between DOT and EPA is lost;

each agency is viewed as part of that same entity "government." Still further evidence that the federal government seems not really serious about fuel conservation is the result of conflict between environmental and fuel economy goals: the continuing requirement that cars, and increasingly trucks, carry emission control equipment which the holder of these views says makes the engine burn more gas, appears contradictory to the purpose of the fuel economy standards.

Other people who accept the sincerity of the philosophy underlying the fuel economy standards nonetheless question their efficacy. They believe the legislation is impotent, with too many loopholes and insufficient stringency. They fear that the corporations will find some way around the law; the more cynical suggest that the whole program is simply a public pacifier, a public relations device, and a meaningless gesture. This is sometimes expressed through resigned sarcasm:

> "Car makers control half the Congress, anyway."
>
> "It's just like the safety standards. They (manufacturers) won't worry about it 'til the last minute and then they will lobby against it and the Congress will change their minds."

3.3 ATTITUDES OF LARGE VEHICLE OWNERS TOWARD THEIR CURRENTLY OWNED VEHICLES AND FUEL EFFICIENT VEHICLES

Large vehicles, i.e., full-sized cars, light trucks, and vans, will be greatly affected by the fuel economy standards in both their design and availability. This section summarizes the attitudes expressed in the group discussions by owners of these vehicles, and the tradeoffs that would be most acceptable. All of these owners are owners of late model vehicles, that is, vehicles that were bought <u>after</u> the 1973-74 Arab Oil Embargo. Furthermore, the owners of the full-sized cars bought their vehicles in a market in which the full-sized car share was about half what it was prior to 1973. These buyers are thus, in some respect, the embattled minority which held out for full-sized cars when others were deserting

the market. In contrast, the light truck buyers bought their vehicles in a rapidly expanding market. They went along with the trend of the times.

3.3.1 Attitudes of Full-Sized Car Owners[1,2]

The reasons for owning full-sized cars varied: physically large drivers who want room inside to stretch out; the desire for luxury and prestige or the "big-car ride"; or people with large families to carry. This last reason makes large cars a requisite for some consumers; these people tend to think the government is penalizing larger families. As one exasperated father put it:

> "How could you get any smaller than a Chevette? Where would you put your wife and family?"

Besides these obvious reasons, the other recurrent theme in all group interviews was safety. Owners of big cars say they feel safer in them. This link between size and safety was nearly universal, although developed most strongly among the large car owners. A common viewpoint expressed was :

> "I'll take the big one and let somebody else take the little one. In an accident it'll kill you. I'll take the steel around me."

Any attempt by the government or private industry to "sell" the fuel economy standards program must address car owners' safety concerns if it is to prove successful. Often these concerns may seem to be a rationalization for resisting downsizing, but they appeared often enough to be an important factor in determining public acceptance of fuel economy standards-inspired vehicles.

The fact that full-size cars have poor gas mileage is generally acknowledged by their owners. Luxury car drivers tend to shrug it off with an "I can afford it." Among others it is frequently argued that driving a big car a relatively low number of miles per year did not entail a disproportionate use of scarce fuel; there is some evidence that in multi-car households the full-sized cars are driven less than the smaller cars. Car pooling was also used

to justify owning a large auto, both in number of miles driven and in the use of scarce fuel.

Full-sized luxury car owners and other full-sized buyers split sharply in the trade-offs they would accept. The former were more willing to give up size. The owners of non-luxury full-sized cars and station wagons would rather sacrifice power than size. Downsizing to the extent of the 1977 GM cars was deemed acceptable, but any greater reduction in size would be considered to have lowered the usefulness of the vehicle.

With some exceptions, full-sized sedan owners did not see the light truck as a reasonable alternative. But for full-sized station wagon owners, vans and pickups were seen as logical alternatives in an era of downsizing.

In all the group interviews, the most consistent attitude on trade-offs concerned material substitution. There was a persistently negative attitude toward the use of light weight materials, especially plastics, mainly for safety considerations, but also because of the belief that plastic-like materials break more easily and would thus require costly repair more frequently. The example usually cited was the Corvette with its fiberglass body.

The safety issue is the keystone which holds together much of the negative reactions to fuel economy measures. Plastics and fiberglass are rejected because they provided no crash protection, powerful engines are needed to maneuver out of harm's way, big cars provide better visibility, heavy cars are less likely to turn over in an accident, and so on. These concerns can be addressed; small car owners have already done it. Others may need help in doing it.

3.3.2 Attitudes of Pickup Owners[1]

Pickup owners, who were nearly exclusively male in the group interviews, are happy with their vehicles, perhaps happier than any other class of owners. Since most pickups are owned jointly with a passenger car, they often are "his" vehicle, while the sedan may be "hers" and the family car. In other words, interviews with the women of pickup owning households may have yielded quite different results.

The pickup's versatility in handling both work and recreation duties is particularly prized by these owners; pickups are typically bought to fulfill multiple, unrelated purposes.

Owners are impressed with visibility and comfort afforded by the pickup cab, with the ease of maintenance and with the greater durability of the pickup truck. Owners are hard pressed to find faults with pickups, although occasionally mentioning limited cab space.

Surprisingly, there is little dissatisfaction with fuel economy. In fact, the most typical perception of gas mileage as a problem is to admit that pickups do not get very good gas mileage, and then to point out that cars get even worse mileage. As an example:

> "I have a V-8 and I average 20 to 22 miles on mine, and my wife had one of those Mustang II fastbacks and she was supposed to get 25 on the highway with that, and the most we ever got was 18."

Another favorite comparison is with the station wagon. Pickup owners, many of whom are previous station wagon owners, believe that pickups do as well as station wagons, especially when heavily loaded.

The only real complaints about fuel economy concerned emission control devices. In these cases, the owners vented their anger toward the EPA, and not at the manufacturer or at pickups as a vehicle class. Pickup owners, unlike car owners, did not reject EPA mileage estimates as misleadingly high, perhaps because

expected gas mileage is a purchase consideration for cars and not for trucks. Pickup owners stated that they disliked emission control devices because of the adverse impact on fuel economy. In fact, avoidance of catalytic converters led many pickup purchasers to buy larger trucks which at that time were not included under EPA regulation. This was especially true for owners of the so-called "5/8 ton" rated pickups; many of those owners even thought of their purchase as half-ton trucks. Overall, pickups over 6000 lbs GVWR were purchased to avoid a catalytic converter about 40 percent of the time. The 5/8 ton seemed to be almost invariably purchased for emissions avoidance:

> "I got a 5/8 ton and the Ford Motor Company saved me some money because I can now use regular gasoline. It was a big selling factor for me."

In discussing trade-offs, there were strongly negative attitudes toward downsizing. Conventional pickup owners do not all like small imported pickups. The most typical reaction was to refuse to take them seriously as trucks:

> "It's a half-ton kiddy car."

> "I got in one and that was the end of that.....the back end is just like a baby's playpen.....they look nice, but there is very little utility there."

The indictments against these vehicles involve cab room, ride, lack of durability, and poor gas mileage when towing or under load:

> "....the engines don't hold up."

> "I had a Datsun pickup for a little while, but a little heavy hauling wiped out the plugs and the damn thing beat me to death. Every little hump you hit feels like an airplane taking off."

Of prime importance is the maintenance of adequate carrying capacity. This was usually defined as the ability to carry a 4 foot by 8 foot plywood panel lying flat. As one owner put it:

> "With my Ford, I can take and put as many as 25 to 30 sheets of plywood in there and still maintain a reasonable load."

Next to outright downsizing, the least acceptable alternative was light weight materials, probably because this clashes with the image of durability. Some safety considerations were also present:

> "Plastic will give me an unsafe feeling. You get hit and it will fly apart like a cardboard box, like a Corvette."

Among those who accepted some use of light-weight materials, aluminum and high alloy steel were clearly preferred to plastic and fiberglass.

Rather than downsize or drive "plastic" trucks to save gas, pickup owners were much more willing to give up some power. Horsepower reductions appear acceptable as long as sufficient torque is maintained. Diesel engines were considered acceptable, although most owners are cognizant of the diesel's shortcomings in terms of noise, odor, cold starts, and initial costs.

3.3.3 Attitudes of Van Owners[1]

Compared to full-sized car owners and pickup owners, the owners of vans seem to be more people-oriented. They talk more about being able to haul large numbers of people or to sleep in them, or to decorate them as they choose. In short, a van is a highly mobile human environment. Although people emphasize some features and de-emphasize others in accordance with the use for which they purchased the van, the tendency to see vans as more than "mere vehicles" is pronounced among all types of owners.

For commercial owners, the van provides a secure storage space for tools and materials, a storage space which can be readily moved from job to job. The overriding importance of this van benefit becomes clearer as commercial van owners readily concede the superiority of pickups in driveability, safety, load capacity, and the ability to handle tall objects and to take overloading without radical handling deterioration. On weekends these same work vans are frequently regarded as the "pleasure people environments," but during the workweek their commercial utility is prized.

The appeal of a movable environment is much more clearly articulated by those who use their vans primarily for pleasure. Owners offered many images of members of the family sprawling out, sleeping while traveling, and taking everything they want on trips. And over and over again, the importance of moving-around room was stressed:

> "What I like about the vans is the freedom of movement. You don't have to hop over the seats like you do with a station wagon and you don't have to go outside to get to the camper."

This is a major element in the movement, typical of these people, from station wagon to van ownership:

> "A big station wagon costs as much, or more, and doesn't have as much room."

> "After a van, I don't know why I ever had a station wagon."

Another important appeal of vans is linked with the movable environment notion. For want of a better term, we may say that van owners see their vehicles as liberating them somehow from the boredom and constrictions of everyday life by providing safe adventure. This observation flows from the number of times owners mentioned appeals like "the security of knowing that you can conveniently go...no preparation...the stuff you need is in the van already..." The van seems to symbolize freedom, by allowing people to view themselves, somewhat romantically, as footloose and fancy free, in the American tradition of the carefree rover. This suggests almost a self-contained little world which moves to the van owner's whim and no one else's.

Of course, vans are also cargo carriers, and they are used for this purpose, at least occasionally, by virtually all owners. Vans have the advantage of assuring privacy in this regard. Additionally, cargo may be stacked higher in vans than in pickups. Unlike pickup owners, when discussing size, van owners impose no invariant material dimension requirement analogous to the 4 foot x 8 foot sheet of plywood.

The meaning of all of this is that interior space is a critical vehicle attribute to the van owner, not merely on grounds of utility and cargo capacity, but because it affects the size of his domain. A number of owners made statements suggesting that size is, in itself, a desirable characteristic. Thus it is hardly surprising that van owners lack a strong predilection for downsizing. They would give up power before giving up anything else:

> "I think we all agree that we will take a reduction in power but not a reduction in size."

Increased use of lighter weight materials was almost as unpopular as downsizing. Plastics, in particular, were rejected on safety grounds. Other materials, along with plastics, were seen as having adverse effects on vehicle handling in crosswinds and on durability:

> "I had to buy four replacement rims because they cracked. That's what happened when they lightened them up."

Poor fuel mileage is the major perceived disadvantage of vans, but it was usually glossed over or given little emphasis in the focus groups. Many van owners took the position that they are doing as well, or better, in their vans as are auto owners:

> "Gas mileage with the van isn't bad when you compare it to my Pinto."

To sum up, van owners talk as though they have escaped limitations which still bind car owners, and can thus do more things with more people in more places, at least potentially. This leads to an almost euphoric satisfaction with vans that is typical of van owners:

> "I never owned a more perfect vehicle for my family."
>
> "Where have you been all my life?"
>
> "I kick myself for not getting one instead of a wagon in 1970."

3.4 REFERENCES FOR SECTION 3

1. National Analysts, Consumer Behavior Toward Fuel-Efficient Vehicles - Second Cycle. Prepared for U.S. Department of Transportation, National Highway Traffic Safety Administration, July 1979.

2. Charles River Associates, Consumer Behavior Towards Fuel Efficient Vehicles. Prepared for U.S. Department of Transportation, National Highway Traffic Safety Administration, Final Report, April 1979.

3. National Analysts, op. cit. p. 54.

4. Market Facts, Inc., A Study of Consumer Behavior Towards Fuel Efficient Vehicles. Prepared for U.S. Department of Transportation, National Highway Traffic Safety Administration, Interim Report, June 1979.

4. FACTORS THAT INFLUENCE VEHICLE-TYPE CHOICES

This chapter summarizes the variables which significantly influence vehicle ownership through distinctly causal relationships. Section 4-1 presents data and analyses relating single vehicle household characteristics and vehicle-type choices; Section 4-2 explores vehicle-type choices of one- and two-vehicle households.

4.1 VEHICLE-TYPE CHOICE RELATIONSHIPS

4.1.1 Household Size

4.1.1.1 NTS Data - It seems intuitive that larger households would own larger vehicles; this relation can be checked with data from the National Science Foundation, National Transportation Survey (NTS) of 1978. Table 4-1 presents the distribution of auto size (as measured by curb weight) as a function of household size. Light trucks are excluded from this analysis, since for these vehicles, curb weight is a poor measure of vehicle passenger capacity. While some of the extreme relationships generally conform to expectations - e.g., domestic compacts and subcompacts* are more likely to be held by single person households than households of five or more persons - overall, the relationship between household size and weight of auto owned does not appear to be strong.

4.1.1.2 Wharton EFA Model[1] - The Wharton Econometric Forecasting Associates (WEFA) Automobile Demand Model employs family data rather than household data. While this leads to little distortion for data from the 50's or earlier, it introduces substantial discrepencies if compared to household figures of the 70's. Table 4-2 demonstrates the changing composition of American households.

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*The four domestic auto weight classes generally correspond, for the great majority of the total fleet, to a subcompact, compact, intermediate, and full-sized vehicle classification.

Note: Superscripts refer to references in Section 4.3.

TABLE 4-1. AUTOMOBILE WEIGHT DISTRIBUTION BY HOUSEHOLD SIZE FOR SINGLE VEHICLE HOUSEHOLDS

	Auto Weight (in pounds)						
	Domestic				Foreign		Total
Household Size	Under 3,000	3000-3499	3500-3999	4000 and over	Under 2100	2100 and over	
One Person	17.6%	18.0%	21.5%	27.5%	4.9%	10.7%	100%
Two Persons	12.7%	24.3%	18.0%	36.2%	5.7%	3.1%	100%
Three Persons	13.8%	24.5%	19.6%	28.4%	7.6%	6.3%	100%
Four Persons	19.1%	18.2%	23.9%	27.7%	6.7%	4.4%	100%
Five or More Persons	10.5%	23.9%	23.2%	30.7%	7.7%	4.0%	100%
Proportion of all autos in this weight class	14.1%	22.6%	20.9%	31.1%	6.7%	4.7%	100%

Sample Base: 1300 Automobiles.

Source: NTS Survey of 1978.

TABLE 4-2. COMPOSITION OF AMERICAN HOUSEHOLDS, 1950 AND 1978

	1950		1978	
	Number (Millions)	Percent	Number (Millions)	Percent
Total Households	43.55	100.0	76.03	100.0
Family Households	38.84	89.2	56.96	74.9
Non-Family Households	4.71	10.8	19.07	25.1

Sources: Statistical Abstract of the United States, U.S. Department of Commerce, Bureau of the Census, 1978, p. 43.

U.S. Department of Commerce, Bureau of the Census, Series P-20, No. 327. Issued August 1978.

The Wharton EFA model empirically found a statistically significant positive coefficient for the number of three- and four-member families explanatory variable in its desired mid-size stock share equation, and a weakly positive coefficient for the percent of families with five or more members regressor in its full-size stock share equation. Thus, although the Wharton EFA family data are not directly comparable to the NTS household data, they tend to confirm the hypothesis that larger households purchase larger cars.

This hypothesis, in conjunction with the declining average household size (see Table 4-3), may foretell increasing consumer acceptance of smaller automobiles. However, one caveat should be added: It is possible that average household size will not continue to decline at a rate as great as the 13 percent erosion from 1965 to 1977. For this trend to continue as strongly, fertility rates would have to remain at their currently very low level, and real per capita income gains would be necessary to finance increasing numbers of single person households.

4.1.2 Household Income

4.1.2.1 NTS Data - NTS data on vehicle type choices by household income strata are displayed in Table 4-4. It should first be noted that there is very little variation in vehicle-type choice among

TABLE 4-3. AVERAGE SIZE OF HOUSEHOLDS 1950-77

	1950	1955	1960	1965	1970	1975	1977
Average Size	3.37	3.33	3.33	3.29	3.14	2.94	2.86

Source: Statistical Abstract of the U.S., U.S. Department of Commerce, Bureau of the Census, 1978, p. 43.

TABLE 4-4. VEHICLE TYPE CHOICE BY HOUSEHOLD INCOME

Relative Income in Standardized Budgets	Vehicle-Type				
	Sedan	Station Wagon	Sports Car	Light Truck	Total
0 - .99	67.4%	10.5%	5.0%	17.1%	100%
1 - 1.99	62.5%	9.6%	5.3%	22.6%	100%
Over 2	62.4%	10.6%	6.9%	19.1%	100%
Total	65.2%	9.6%	5.7%	19.5%	100%

Source: Derived from the NTS Survey of 1978.

households of different incomes, according to these data. The greatest variation occurs among sports car and light truck ownership. The highest income stratum shows the strongest proclivity for owning sports cars, and the middle income households exhibit the highest propensity to own light trucks. However, these light truck data fail to fully describe the substantial expansion in the light truck (pickups, vans, and utility/jeep vehicles under 8500 pounds GVW) segment of the vehicle market of recent years. The light truck growth will be more fully discussed in Section 6.2.

Table 4-5 gives the auto weight distribution by household income. The expected increase in the presence of the largest vehicles (domestics over 4,000 lbs) with income did not appear in the NTS sample. In fact, the proportion of very large vehicles was relatively constant with income. Domestic vehicles under 3,000 pounds are less prevalent with increasing income, but the decrease in these vehicles is accounted for by increases in both small and large foreign vehicles, rather than larger luxury domestics. Foreign vehicles account for nearly 17 percent of the fleet held by high income households, significantly higher than in lower income households.

4.1.2.2 Newsweek Data - Newsweek's "Buyers of New Domestic Cars 1979" (Table 4-6) allows an examination of income versus auto size trends for domestic autos. As auto size increases from Category 1 through Category 5 (see Table 4-7 for descriptions), both median and mean household income show a clear upward trend. More income implies larger autos.

4.1.2.3 Wharton EFA Model - The disaggregated Wharton EFA desired stock equations show the current income relative to total average capitalized costs per mile of auto travel (YDI/FM/CT*Q) variable to have an increasing coefficient with auto size (Table 4-8). The YDI/FM/CT*Q variable is supposed to represent a "trading up or down" phenomenon. If income increases relative to the costs

TABLE 4-5. AUTOMOBILE WEIGHT DISTRIBUTION BY HOUSEHOLD INCOME

Relative Income (in standardized budgets)	Auto Weight (in pounds)						
	Domestic				Foreign		Total
	Under 3000	3000-3499	3500-3999	4000 and over	Under 2100	2100 and over	
0 - .99	17.1%	23.3%	19.2%	31.7%	5.5%	3.2%	100%
1 - 1.99	14.6%	22.0%	23.6%	29.2%	6.3%	4.3%	100%
over 2	8.8%	21.9%	19.5%	32.9%	8.1%	8.8%	100%

Sample Base: 966 Automobiles.

Source: NTS Survey of 1978.

TABLE 4-6. TOTAL RESPONDENTS - HOUSEHOLD INCOME

	** DOMESTIC CAR CATEGORIES **						
	CATEGORY 1	CATEGORY 2	CATEGORY 3	CATEGORY 4	CATEGORY 5	CATEGORY 6	CATEGORY 7
	TOTAL	SUB-COMPACTS	COMPACTS	INTER-MEDIATES	FULL SIZE	LUXURY	SPORTY COUPES	SPECIALTY COUPES
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
UNDER $5,000	2.1	2.7	1.7	1.8	1.9		3.7	1.0
$5,000-$7,499	3.3	6.1	3.3	2.5	1.9	1.0	4.5	3.4
$7,500-$9,999	3.2	6.1	5.7	.9	1.7	.5	5.2	2.4
$10,000-$12,499	5.5	9.5	7.0	4.6	3.8	.5	8.3	2.4
$12,500-$14,999	6.0	6.1	8.0	9.2	3.6	.5	6.4	5.4
$15,000-$17,499	5.0	4.6	12.0	3.9	3.6	.5	5.8	3.7
$17,500-$19,999	6.8	7.6	12.4	5.8	5.6	3.5	4.3	10.2
$20,000-$22,499	8.4	9.5	9.7	9.7	7.5	2.5	8.0	10.2
$22,500-$24,999	8.3	13.4	10.0	9.0	7.7	3.5	7.0	8.5
$25,000-$34,999	21.1	17.6	16.4	21.7	28.8	15.2	20.4	19.7
$35,000-$49,999	16.8	13.4	7.7	17.3	19.8	23.2	12.8	25.1
$50,000-$74,999	8.5	2.7	5.0	9.0	9.4	19.2	9.3	5.8
$75,000-$99,999	2.5		1.3	2.8	1.3	10.1	2.9	2.0
$100,000 & OVER	2.7		.3	1.8	2.9	18.7	1.4	.7
MEDIAN (THOUSANDS OF DOLLARS)	25.8	21.8	20.1	26.2	29.3	49.0	23.9	26.6
MEAN (THOUSANDS OF DOLLARS)	32.3	22.9	24.3	32.3	34.0	61.0	29.4	31.0

Source: Reference 3.

TABLE 4-7. NEWSWEEK DOMESTIC CAR SAMPLE

The sample used in the Newsweek project is 3,223 buyers of new domestic cars.

The names of those buyers were provided by R.L. Polk & Co. of Detroit from registration records for January and February, 1979.

Category 1
Subcompacts

Bobcat
Chevette
Horizon (4 Dr.)
Monza (2 Dr. Wagon)
Omni (4 Dr.)
Pinto
Spirit
Sunbird (2 Dr. Wagon)

Category 2
Compacts

Aspen
Concord
Fairmont/Futura
Granada
Monarch
Nova
Omega
Pacer
Phoenix
Skylark
Volare
Zephyr/Z-7

Category 3
Intermediates

Century
Cougar (except XR7)
Cutlass
Diplomat
LeBaron
LeMans/Grand Am
LTD II
Malibu
Regal

Category 4
Full Size

Buick
Chevrolet
Chrysler
Dodge
Ford
Mercury
Oldsmobile
Pontiac

Category 5
Luxury

Cadillac
Continental
Corvette
Eldorado
Mark V
Riviera
Seville
Toronado
Versaille

Category 6
Sporty Coupes

AMX
Camaro
Capri
Firebird
Horizon TC3
Monza (except Wagon)
Mustang
Omni 024
Skyhawk
Starfire
Sunbird (except Wagon)

Category 7
Specialty Coupes

Cordoba
Cougar XR7
Grand Prix
Magnum
Monte Carlo
Thunderbird

Source. Reference 3.

TABLE 4-8. ESTIMATED INCOME COEFFICIENTS IN THE WHARTON EFA MODEL

Equation	Variable	
	YDI/FM/CT*Q	PER15+
Desired Combined Subcompact and Compact Stock Share	-1.169 (-2.91)	0.378 (2.89)
Desired Mid-size Stock Share	-0.161 (-1.31)	--
Desired Full-size Stock Share	0.832 (3.01)	-0.506 (-6.10)
Desired Luxury Stock Share	--	0.210 (2.12)

(t - statistics in parentheses)

where: YDI = Current dollar disposable income

FM = number of family units

CT*Q = fixed-weighted average cost per mile of passenger cars

PER15+ = percentage of families with real income in excess of $15,000 (in 1970 dollars).

of owning and operating a new automobile, it is hypothesized that this will result in an upgrading of new car purchases, with more expensive cars gaining at the expense of more economical ones. Conversely, if auto costs increase relative to income, it is asserted that this will result in a downgrading of new car purchases, with less expensive cars being bought more readily than more expensive ones. In terms of the estimated coefficients shown in Table 4-5, full-sized cars gain the most from "trading up," with small cars (subcompact and compact) strongly losing market share and mid-size cars showing a weak tendency for a small net loss in share.

The PER15+ income distribution variable also plays a significant role in the desired share equations. Increasing affluence (families with incomes greater than $15,000 in 1970 dollars) implies gains in the luxury and small car shares at the expense of the full-size share. The gain in the luxury share is certainly to be expected; the gain in small car share is less obvious and pre-

sumably reflects additions to the household stock of cars (second and third cars) in response to greater household wealth. These additional cars are frequently small and more fuel efficient because of the phenomenon of "functional specialization" (See Section 4.2).

The use of the YDI/FM/CT*Q and PER15+ variables in the Wharton disaggregate desired stock equations yields theoretically satisfactory and corroborable results. Wharton's total desired stock per family equation, however, is untenable on the basis of empirical data. The equation contains two income variables: real permanent income per family (RDIP4/FM) and percentage of families earning $15,000 or more in 1970 dollars (PER15+). The RDIP4/FM variable has the anticipated positive sign because an increase in income, other things being equal, should increase the desired stock of cars. The PER15+ variable is estimated to have a negative sign because the Wharton authors believe it represents a "saturation effect." Under this model, as the percentage of families with real incomes greater than $15,000 increases, the desired stock tends to decrease. The interaction of the RDIP4/FM and PER15+ income variables implies that the long-run income elasticity with respect to new car sales volume is essentially zero. In other words, Wharton's results indicate that greater long-term affluence has no net impact on auto sales; the "saturation effect" negates the increase from the positively-signed RDIP4/FM explanatory variable.

A long-run income elasticity with respect to new auto sales of zero is implausible because, simply put, the Wharton "saturation effect" at incomes above $15,000 is not supported by the data. Table 4-9 demonstrates that the highest income quintile (corresponding to families with incomes in excess of $15,000 in 1970 dollars) increased automobile ownership from 1970 to 1977, as mean income within the quintile rose from $21,652 to $22,593 in 1970 dollars.[2] Speficially, the percentage of families in this group owning more than one vehicle increased by 22 percent (from 69 percent to 84 percent). This does not show any saturation in automobile ownership for high income families; it indicates the opposite.

Table 4-10 presents the same picture. Average number of auto-

TABLE 4-9. VEHICLE OWNERSHIP 1970 AND 1977 (PERCENTAGE DISTRIBUTION OF ALL FAMILIES)

Family Income Quintiles	No Vehicles		One Car, No Truck		Multi-Car, No Truck		Multi-Car, Truck		One Car, Truck		Truck Only		All Families	
	1970	1977	1970	1977	1970	1977	1970	1977	1970	1977	1970	1977	1970	1977
Lowest Quintile	46	39	39	40	4	7	1	1	5	6	5	7	100	100
Second Quintile	19	11	53	51	10	15	2	4	13	13	3	6	100	100
Third Quintile	5	3	46	41	24	27	4	5	19	21	2	3	100	100
Fourth Quintile	4	4	41	23	36	41	5	8	15	21	*	3	100	100
Highest Quintile	4	3	27	12	50	53	9	13	10	18	*	1	100	100

*less than 0.5 percent.

Source: 1977 Survey of Consumer Finances.

TABLE 4-10. SELECTED AVERAGE FAMILY DATA CLASSIFIED BY CURRENT DOLLAR FAMILY INCOME BEFORE TAXES

	Under $3,000	$3,000 to $3,999	$4,000 to $4,999	$5,000 to $5,999	$6,000 to $6,999	$7,000 to $7,999	$8,000 to $9,999	$10,000 to $11,999	$12,000 to $14,999	$15,000 to $19,999	$20,000 to $24,999	$25,000 and over
Number of Automobiles Owned	.5	.7	.8	1.0	1.0	1.2	1.3	1.4	1.6	1.8	2.0	2.1
Percent Owning at Least One Automobile	38.3	55.5	63.0	69.8	75.9	82.1	87.1	91.3	94.8	96.9	97.1	95.2
Expenditure Categories: (Current Dollars)												
Tobacco Products and Smoking Supplies	66.75	79.35	88.13	99.99	109.69	120.25	132.23	143.72	154.41	173.57	169.05	161.27
Eggs	17.43	24.26	24.53	27.39	26.86	29.82	28.90	30.99	31.89	34.81	33.18	36.07
Clothing	140.55	217.84	248.73	301.77	335.80	395.14	451.98	538.65	612.16	794.19	993.45	1,427.23
Vehicle Purchases (net)	182.09	208.36	292.41	321.03	471.73	515.81	585.70	779.32	859.49	1,023.49	1,227.88	1,511.16

Source: Consumer Expenditure Survey: Integrated Diary and Interviews Survey Data, 1972-3. U.S. Department of Labor, Bureau of Labor Statistics, 1978. Bulletin 1992.

mobiles owned per family increases across the board with income. There is no inkling of saturation as families move beyond the $15,000 - $19,999 income bracket (the group in which families with incomes greater than $15,000 in 1970 dollars belong). The percentage of families owning at least one car does peak, however, at about 97 percent with this income category. Increased average auto ownership must therefore result from increased multiple car ownership. This result is already discernible from data in Table 4-9.

Average family expenditures in several categories are also included in Table 4-10. Spending for eggs and tobacco products shows some evidence of saturation at high income levels. Clothing expenditures, on the other hand, increase tremendously with income, with the greatest increase evident for the highest income segment. Net vehicle purchases increase dramatically with income, showing absolutely no tendency for saturation at incomes above $15,000.

This evidence dispels auto ownership saturation at incomes above $15,000 in 1970 dollars; however, this is not to say that a point of saturation is never reached. Indeed, it is quite probable that at very large family incomes - perhaps above one hundred thousand dollars - a saturation phenomenon does occur.* Wharton has a reasonable concept; an injudicious selection of income saturation level undermines it.

4.1.2.4 Income and Age of Used Cars - For vehicles which had been purchased by NTS households, the average age of the vehicle at the time of purchase was calculated for each relative income category. As expected, higher income households purchased newer used vehicles than lower income groups. The average ages of used vehicles were 5.0 years, 4.9 years, and 4.4 years for households with relative incomes of under 1, 1-1.99, and 2 or higher standard budgets, respectively. Although the average age differential between the highest and lowest income group is low (0.6 years), Figure 4-1 shows that the distribution of ages at purchase for each income

*The data needed to test this are unavailable.

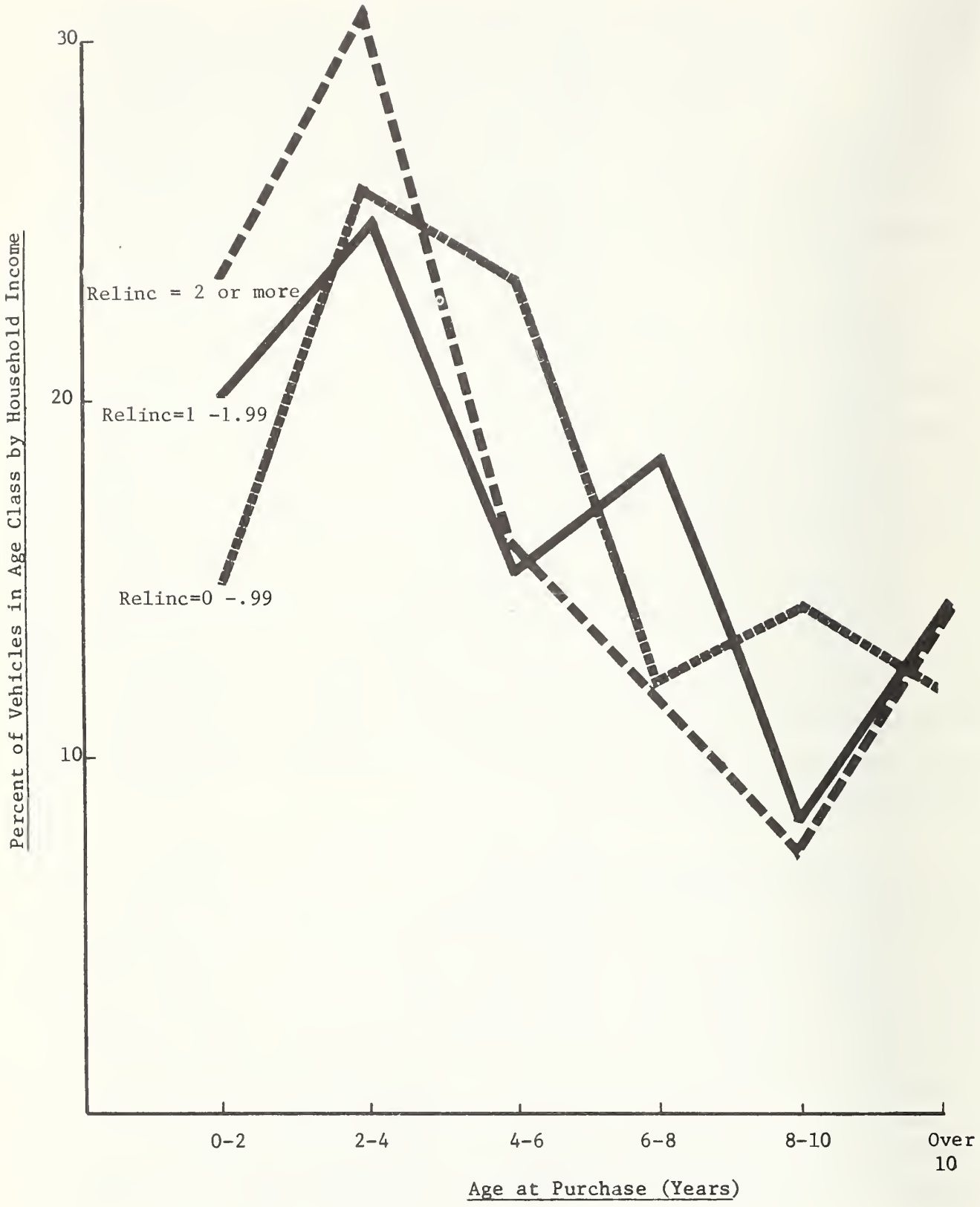


FIGURE 4-1. AGE OF USED VEHICLES AT TIME OF PURCHASE BY RELATIVE HOUSEHOLD INCOME

group differs significantly. High income households in the NTS sample purchasing a used vehicle were much more likely to acquire a relatively new vehicle (under four years in age) than low income households. For example, just under 54 percent of the used vehicles purchased by high income households were less than four years old, while only 40 percent of the used vehicles purchased by the lowest income households were of such recent vintage.

4.1.3 Age of Household Head

4.1.3.1 NTS Data - Variations in vehicle type choice by age of the household head in the NTS sample are displayed in Table 4-11. Households with heads over age 50 are somewhat more likely than other households to own sedans and somewhat less likely to own light trucks. Households with heads of between 31 and 49 years of age are more likely than other households to own station wagons, indicative of the prevalence of children in this household group. Not surprisingly, more younger household heads own sports cars, reflecting differences in their family size and preferences.

Table 4-12 shows the distributions of vehicle weight with respect to age of the head of household. Age of the head exhibits a much stronger and more systematic effect on observed household auto size than income or family size (Tables 4-1 and 4-5). In all domestic weight classes, older consumers display a consistent preference for relatively heavy vehicles. The share of domestic full size and luxury cars (4000 pounds and over) among households headed by an individual 50 or over is more than double the corresponding share for household heads under 30. An opposite relationship is observed for the subcompact and compact car classes, where young households display a marked relative preference for light autos. In addition, foreign cars appear to be much more popular with younger heads than older ones, as the percentage of both large and small imports decreases with age of the household head.

TABLE 4-11. VEHICLE TYPE CHOICE BY AGE OF THE HOUSEHOLD HEAD

Age of Household Head	Vehicle-Type				
	Sedan	Station Wagon	Sports Car	Light Truck	Total
30 or less	61.7%	6.9%	10.4%	21.0%	100%
31 - 49	63.5%	11.8%	4.5%	20.1%	100%
Over 50	68.2%	8.4%	5.2%	18.2%	100%
Total	65.2%	9.6%	5.7%	19.5%	100%

Source: Derived from the NTS Survey of 1978.

TABLE 4-12. AUTOMOBILE WEIGHT DISTRIBUTION BY AGE OF HOUSEHOLD HEAD

	Auto Weight (in pounds)						
	Domestic				Foreign		Total
Age of Household Head	Under 3000	3000-3499	3500-3999	4000 and over	Under 2100	2100 and over	
Under 30	17.8%	28.5%	18.5%	16.6%	11.2%	7.3%	100%
30 - 49	15.6%	21.5%	19.1%	30.4%	8.0%	5.4%	100%
50 and over	11.4%	22.0%	23.3%	36.0%	4.1%	3.2%	100%
Proportion of all autos in this weight class	14.1%	22.6%	20.9%	31.1%	6.7%	4.7%	100%

Sample Base: 1366 Automobiles.

Source: NTS Survey of 1978.

4.1.3.2 Newsweek Data - Newsweek data (Table 4-13) generally substantiate the conclusions from NTS data. The heaviest domestic cars (categories 4 and 5) were purchased more frequently by the 50-64 registered owner age group than younger age groups. The median owner ages for these two categories (full-sized and luxury) are higher than for any other category. The 18-34 age group bought 50 percent of all sub-compacts; but, contrary to the NTS survey, ownership of new compact cars is relatively constant among every age stratum up through the 50-54 age group. The oldest (over age 54) owners, however, bought the largest fraction of new compacts, and the 55-64 age group purchased the second greatest share of both new sub-compacts and compacts. Finally, the median age of all new domestic car buyers was 41.1 years;[3] for new import car buyers it was 36.6 years.[4]

4.1.3.3 Cambridge Systematics, Inc. - The Cambridge Systematics, Inc. (CSI) vehicle-type choice model estimates the importance of various vehicle design characteristics to different demographic groups. Their results confirm the positive correlation between vehicle weight and age of household head. Table 4-14 shows the estimated coefficients for their one-vehicle household model, and Table 4-15 gives the analogous estimates for the two-vehicle household model. Each model has a significantly positive estimated coefficient for vehicle weight if the household head is age 45 or older, and lacks such a significant coefficient for younger household heads. Thus households with older heads greatly prefer heavier cars, while households with younger heads are indifferent to vehicle weight

4.1.4 Education of Household Head

4.1.4.1 NTS Data - Table 4-16 displays vehicle-type choice by education of household head in the NTS sample. Higher educated individuals are much more inclined to own station wagons. Sedan ownership is relatively constant across all education levels. Lesser educated individuals have a greater tendency to own pickups,

TABLE 4-13. REGISTERED OWNER - AGE (BY PERCENT)

	** DOMESTIC CAR CATEGORIES **							
	TOTAL	CATEGORY 1 SUB-COMPACTS	CATEGORY 2 COMPACTS	CATEGORY 3 INTER-MEDIATES	CATEGORY 4 FULL SIZE	CATEGORY 5 LUXURY	CATEGORY 6 SPORTY COUPES	CATEGORY 7 SPECIALTY COUPES
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
UNDER 18	.2		.3				1.1	
18-24	12.9	14.2	7.6	6.3	2.9	1.2	34.2	18.7
25-29	12.4	22.3	9.4	13.0	3.4	6.0	18.6	16.5
30-34	13.7	13.0	12.8	18.5	11.7	10.4	11.4	17.7
35-39	8.9	7.2	8.6	11.0	8.6	9.6	8.2	8.9
40-44	9.0	6.3	9.6	10.1	9.3	13.3	6.1	11.0
45-49	8.4	6.9	8.6	8.3	11.4	10.4	6.8	6.1
50-54	10.2	7.2	8.3	9.1	16.7	13.7	6.7	8.6
55-64	16.0	18.1	20.8	14.0	23.5	23.3	5.8	9.8
65 AND OVER	8.2	4.8	14.1	9.7	12.7	12.4	1.4	2.4
MEDIAN (NUMBER OF YEARS)	41.1	35.4	46.1	40.6	50.9	49.6	29.0	34.1
MEAN (NUMBER OF YEARS)	41.9	39.5	45.7	42.5	48.9	48.6	32.7	36.7
UNWEIGHTED BASE	2993	453	561	472	412	411	495	189

Source: Reference 3.

TABLE 4-14. SELECTED PARAMETER ESTIMATES IN CSI ONE-VEHICLE CHOICE MODEL

Variable Name	Estimated Coefficient	Asymptotic t-statistic
Vehicle Weight (10^3 lbs) if HH age $\leq$30	-.0431	-.14
Vehicle Weight (10^3 lbs) if HH age 30-45	.336	1.05
Vehicle Weight (10^3 lbs) if HH age $\geq$45	.752	2.53

Source: CSI - An Empirical Analysis of Household Choice Among Motor Vehicles, 1979.

TABLE 4-15. SELECTED PARAMETER ESTIMATES IN CSI TWO-VEHICLE CHOICE MODEL

Variable Name	Estimated Coefficient	Asymptotic t-statistic
Vehicle Weight (10^3 lbs) if HH age $\leq$30	.00978	.03
Vehicle Weight (10^3 lbs) if HH age 30-45	.282	1.00
Vehicle Weight (10^3 lbs) if HH age $\geq$45	.758	2.52

Source: CSI - An Empirical Analysis of Household Choice Among Motor Vehicles, 1979.

TABLE 4-6. VEHICLE-TYPE CHOICE BY EDUCATION OF HEAD OF HOUSEHOLD

Education of Head of Household	Vehicle-Type				
	Sedan	Station Wagon	Sports Car	Light Truck	Total
Less than High School Diploma	69.1%	7.3%	3.4%	20.2%	100%
High School Diploma	63.8%	7.6%	5.4%	23.2%	100%
College	65.6%	14.9%	6.8%	12.7%	100%
Graduate Study	65.6%	15.7%	5.4%	13.2%	100%
Total	65.2%	9.6%	5.7%	19.5%	100%

Source: Derived from NTS Survey of 1978.

probably because this group includes many farmers and tradesmen who use their vehicles in line with work-related hauling duties.

4.1.4.2 Newsweek Data - Newsweek data (Table 4-17) show that people who have attained higher educational levels prefer sub-compacts, intermediates, luxury cars, and sporty coupes. These findings are not at variance with the NTS data.

4.1.5 Sex of Principal User

4.1.5.1 NTS Data - Table 4-18 indicates that most women drive passenger autos (84 percent), and very few drive light trucks (5 percent). On the other hand, 30 percent of the men are primary drivers of trucks.

4.1.5.2 Newsweek Data - Newsweek (Table 4-19) show that women prefer, among passenger cars, compacts, sporty coupes, and specialty coupes, whereas males show a marked preference for full-sized and luxury cars.

4.1.6 Activity of Primary User

NTS Data - Table 4-20 relating vehicle type to individuals' primary activity yields the expected results. For example, homemakers are the most frequent users of station wagons and the least frequent users of pickup trucks. This result is consistent with homemakers' typical vehicle for shopping and chauffeuring children. At the other extreme, students, who typically have no family travel requirements, exhibit the highest ownership of passenger autos. A somewhat surprising result is that a nearly equal proportion of retired individuals and full-time workers are the primary users of a truck. Only 6.3 percent of the vehicles primarily driven by retirees were station wagons, possibly reflecting their limited obligations for chauffeuring childern.

TABLE 4-17. REGISTERED OWNER - EDUCATION (BY PERCENT)

	**	DOMESTIC CAR CATEGORIES						**
		CATEGORY 1	CATEGORY 2	CATEGORY 3	CATEGORY 4	CATEGORY 5	CATEGORY 6	CATEGORY 7
	TOTAL	SUB-COMPACTS	COMPACTS	INTER-MEDIATES	FULL SIZE	LUXURY	SPORTY COUPES	SPECIALTY COUPES
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
		1.49	1.82	.6	1.4	1.07	.24	.62
GRADE SCHOOL	4.5	6.7	8.2	2.7	6.3	4.8	1.1	2.8
HIGH SCHOOL	33.8	33.8	39.8	29.7	39.2	29.3	29.4	34.3
ATTENDED COLLEGE	27.1	19.5	24.4	26.2	25.7	25.7	30.1	37.0
GRADUATED COLLEGE	19.9	22.6	14.9	24.1	16.9	20.5	23.5	15.4
GRADUATE SCHOOL	14.8	17.4	12.5	17.0	12.0	19.3	15.9	10.8
UNWEIGHTED BASE	2984	447	556	472	413	408	497	189

Source: Reference 3.

TABLE 4-18. VEHICLE TYPE RELATED TO SEX OF THE PRIMARY USER (REPORT OF VEHICLES DRIVEN BY MALE AND FEMALE PRIMARY USERS)

Vehicle Type	Sex of User	
	Male	Female
Passenger Auto	61.5%	84.1%
Station Wagon	8.6%	10.6%
Light Truck	29.9%	5.3%
Total	100%	100%

Source: NTS Survey of 1978.

TABLE 4-19. PRINCIPAL DRIVER - SEX (BY PERCENT)

	** DOMESTIC CAR CATEGORIES **						
	CATEGORY 1	CATEGORY 2	CATEGORY 3	CATEGORY 4	CATEGORY 5	CATEGORY 6	CATEGORY 7
	TOTAL	SUB-COMPACTS	COMPACTS	INTER-MEDIATES	FULL SIZE	LUXURY	SPORTY COUPES	SPECIALTY COUPES
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
MALE	58.3	61.3	51.7	60.7	69.3	66.3	48.3	50.6
FEMALE	41.7	39.0	48.3	39.3	30.7	33.3	51.7	49.4
UNWEIGHTED BASE	2973	449	570	466	405	409	486	188

Source: Reference 3.

TABLE 4-20. VEHICLE TYPE RELATED TO ACTIVITY OF THE PRIMARY USER*

REPORTED ACTIVITY OF PRIMARY USERS

Vehicle Type	Workers (full-time)	Students	Homemakers	Retired
Passenger Auto	67.5%	82.9%	74.9%	71.5%
Station Wagon	8.6%	5.9%	17.7%	6.3%
Light Truck	23.9%	11.2%	7.4%	22.2%
Total	100	100	100	100

Sample Base: 1470 Vehicles.

Source: NTS Survey of 1978.

*For the sake of clarity, part-time workers and unemployed individuals reported as primary vehicle users are not reported in this table.

4.1.7 Standard Metropolitan Statistical Area (SMSA) Size

NTS Data - Vehicle type choices by households vary significantly as a function of city size. Table 4-21 reveals passenger cars to be the predominant choice of all households, but particularly of those households residing in SMSA's with more than 2.5 million residents. Pickup truck and utility vehicle ownerships are extremely low in these areas. Interestingly, van ownership is highest in the large SMSA's.

With declining SMSA size, pickup truck ownership increases sharply, with corresponding decreases in passenger car ownership. In rural (non-SMSA) areas, pickups account for fully one-fifth of all vehicles. Passenger cars, on the other hand, account for less than three-fourths of the rural vehicles in contrast to their greater than 90 percent share in large SMSA's.

4.1.8 Region of Country

NTS Data - For any SMSA size, including rural areas, pickup truck ownership was uniformly higher in the West and South than in other areas of the country (Table 4-22). For example, in the mountain region*, 23 percent of the sampled vehicles held were pickups, while the overall average pickup share was only 14 percent. The proportion of passenger cars to total vehicles owned by households varied from below 60 percent in the Mountain States to nearly 90 percent in New England. Van ownership was particularly high in the Pacific States. Other than these exceptions, no significant variations in the composition of the vehicle fleet were observable in the NTS sample.

4.2 VEHICLE-TYPE CHOICES OF ONE- VERSUS TWO-VEHICLE HOUSEHOLDS

There is reason to believe that the factors motivating vehicle type choice decisions in single and multiple vehicle households differ significantly. Essentially, ownership of two or more ve-

*See Section 6.2, Figure 6-2, for a map of the census regions.

TABLE 4-21. VEHICLE TYPE CHOICES BY SMSA SIZE

(Percent of vehicle types within each SMSA size category)

Body Style	SMSA Greater than 2.5 million	SMSA 50,000-2.5 million	Non-SMSA Less Than 50,000
Passenger Car	91.1%	80.6%	74.6%
Van	4.0%	3.1%	2.5%
Pickup	4.9%	13.7%	20.0%
Utility or four wheel drive vehicle	0.0%	1.1%	2.2%
Other	0.0%	1.5%	0.7%
Total	100%	100%	100%

Sample Base: 1758 Vehicles.

Source: NTS Survey of 1978.

TABLE 4-22. VEHICLE TYPE CHOICE BY REGION

(100% = All vehicles in a region)

Region	Pass. Car*	Station Wagon	Pickup	Van	Other	Total
New England	87%	9%	0%	3%	0%	100
Middle Atlantic	75%	14%	8%	2%	1%	100
East North Central	71%	9%	14%	4%	2%	100
West North Central	71%	5%	21%	0%	3%	100
South Atlantic	72%	8%	17%	2%	1%	100
East South Central	77%	4%	19%	0%	0%	100
West South Central	74%	4%	16%	3%	3%	100
Mountain	59%	13%	23%	2%	4%	100
Pacific	65%	12%	15%	5%	3%	100
Proportion of vehicles of this type in all regions	71%	10%	14%	3%	3%	

*Includes all sedans, sports cars, convertibles, and hatchbacks.

Source: NTS Survey of 1978.

hicles allows a household the opportunity to "functionally specialize" their vehicle holdings. For example, primary worker commuting needs might be fulfilled by a relatively small, fuel efficient vehicle, while a station wagon or larger sedan might serve as the family car. Another logical pairing satisfying disparate travel requirements might combine a pickup for occasional hauling needs with a full-sized car for routine family travel. In each example, neither vehicle alone fully meets the household's travel needs, but both together effectively do.

Single vehicle households, of course, do not have the opportunity to functionally specialize their vehicle choices. These households must choose the single vehicle that offers the best compromise given family travel needs. It seems reasonable to expect that these households would often choose relatively larger vehicles, as the desire for fuel economy and ease of handling give way to the need for seating and cargo capacity. It also appears reasonable to expect that single vehicle households would own fewer vehicles with more specialized functions, i.e., station wagons for extra seating capacity or light trucks for extra hauling capacity. These suppositions may be tested by examining data from CSI/Westat, Inc. and the NTS. (Tables 4-23 and 4-24.)

The CSI data (Table 4-23) confirm that single vehicle households choose relatively larger vehicles and far fewer light trucks. These households had an ownership rate 22 percent higher for full-sized and luxury cars than two-vehicle households. In addition, their proportion of light trucks was only one-third the ownership rate for two-vehicle households.

The NTS data (Table 4-24) consider only three broad vehicle classifications. No comparison of the relative sizes of passenger autos owned by one- versus two-vehicle households is possible, but the fact that single vehicle households own fewer more specialized vehicles is readily apparent. The ownership rate for station wagons was 36 percent less; it was 68 percent less for light trucks. As expected, one-vehicle households owned light trucks at a far lower rate than two-vehicle households.

TABLE 4-23. VEHICLE OWNERSHIP PATTERNS: SINGLE- VERSUS TWO-VEHICLE HOUSEHOLDS

Vehicle Type	Fraction of Vehicles in Each Class	
	Single Vehicle Households	Two Vehicle Households
Subcompact/ Compact	.20	.18
Intermediate	.20	.16
Full-sized and Luxury	.38	.32
Foreign	.15	.13
Subtotal	.93	.79
All Light Truck	.07	.21
Total	1.00	1.00

Source: CSI/Westat, Inc., An Empirical Analysis of Household Choice Among Motor Vehicles, 1979.

TABLE 4-24. VEHICLE BODY STYLE IN ONE- AND TWO-VEHICLE HOUSEHOLDS

Vehicle Type	Percent of Households Holding at Least One Vehicle of this Type	
	One-Vehicle Households	Two-Vehicle Households
Passenger Auto	83.4	61.8
Station Wagon	8.6	13.5
Light Truck	8.0	24.7
Total	100.0	100.0

Source: Derived from data produced from 1978 NTS study.

Table 4-25 shows the two-vehicle household ownership pattern derived from CSI data. Most two-vehicle households own two different types of vehicles, in accordance with the "functional specialization" concept from above. In fact, fewer than one household in five owns two vehicles of the same type. Where two vehicles of the same type are owned, the choice is most likely a full-sized or luxury auto. About one-third (32 percent) of all two vehicle households has a fleet that is made up exclusively of large vehicles, i.e., combinations of full-sized, luxury, pickup, van, and/or utility. More than one-fifth of the households has a fleet that is composed entirely of small vehicles, i.e., combinations of subcompact, compact, sport, intermediate, and/or foreign. Over half (54 percent) owns at least one subcompact/compact or foreign car.

4.3 REFERENCES FOR SECTION 4

1. Wharton Econometric Forecasting Associates, The Wharton EFA Automobile Demand Model, Final Report, Prepared for U.S. Department of Transportation, February 1977.
2. U.S. Bureau of the Census, Current Population Reports, Series P-60, No. 117. Issued December 1978.
3. Newsweek, "Buyers of New Domestic Cars 1979," 1979.
4. Newsweek, "Buyers of New Imported Cars 1979," 1979.

TABLE 4-25. TWO-VEHICLE HOUSEHOLD OWNERSHIP PATTERNS
(FRACTION OF HOUSEHOLDS IN CELL)

Vehicle-Type	Subcompact/Compact	Intermediate	Full and Luxury	Foreign	Pickup	Van	Utility	Marginal Probability of Owning at Least one Row-type Vehicle
Subcompact/ Compact	.029	.053	.104	.041	.043	.014	.024	.168
Intermediate		.039	.073	.043	.053	.004	.014	.159
Full and Luxury			.112	.078	.122	.018	.039	.330
Foreign				.018	.020	.018	.012	.124
Pickup					.002	.002	.010	.128
Van						.002	.008	.035
Utility							.002	.056

Source: Derived from data produced by Cambridge Systematics, Inc., under NSF contract C-PRA77-16108.

5. ATTRIBUTES THAT ARE DESIRED IN MOTOR VEHICLES

In general, one would expect that people who purchase vehicles for utilitarian reasons would like a vehicle that is large, comfortable, inexpensive to purchase and operate, and which gets excellent gas mileage. However, in the non-utopian world this is not entirely possible. People must give up certain vehicle attributes (e.g., vehicle size) in order to obtain more valued attributes (e.g., better fuel economy). Thus, the process of choosing a motor vehicle may be viewed as a sequential series of trade-offs that the consumer must make among combinations of valued product/service attributes. This section examines which attributes are most highly prized by vehicle owners. The first results, from Cambridge Systematics, Inc., include explicit estimates of the relative dollar values consumers place on these attribute trade-offs; the Market Facts and National Transportation Survey results that are reported here are more general.

5.1 CSI ESTIMATES OF UTILITIES OF VARIOUS ATTRIBUTES

In general, the CSI vehicle-type choice model clearly points out the importance of seating capacity, vehicle weight, luggage space, vehicle price, and costs.

Among one-vehicle households, the preference is for vehicles with 2.5 seats* in addition to those required to carry all household members. More or fewer seats decreases the utility. For two-vehicle households, the most preferred seating combination is one quite small vehicle and one that is two and one-half seats larger. The latter would be approximately equal to household size. Notably, the larger vehicle in the most preferred pair, with its approximately zero excess seats, is considerably smaller than the 2.5 excess seats vehicle most preferred by one-vehicle households.

*CSI defines a "seat" as equal to 25" of shoulder room.

In both one- and two-vehicle households, greater vehicle weight is a factor of significant importance to heads of households age 45 and over. To heads of household below 30 years of age, vehicle weight is a minor and statistically insignificant factor.

Larger households in general prefer more luggage space. For households of four or more persons with just one vehicle this relationship is significant. For others, the relationship is only of marginal significance.

Low vehicle price is of great importance and highly significant for low income households. For households with higher income and owning just one vehicle, the price of the vehicle is less important and significant only at the five percent level. Lower operating costs are important and significant for low income households with one motor vehicle, and for the owners of pickups and vans.

The magnitudes of the cost term coefficients relative to the coefficients of other attributes reveal several useful insights into the tradeoffs one-vehicle households make in choosing a vehicle. Table 5-1 summarizes the implied marginal rates of substitution derived from the coefficients of explanatory variables in the one-vehicle model. A close examination of fuel cost vs. purchase price will serve to facilitate interpretation of the data. (Table 5-2).

The implied marginal rates of substitution between fuel cost and purchase price suggest that at least some consumers place an extremely high value on vehicle efficiency. For a vehicle driven an average of 15,000 miles per year, a one cent per-mile improvement in fuel economy is worth $(15,000)\cdot(.01)$ or $150 a year. Thus, the rational household which drives 15,000 miles per year should be willing to spend up to $150 in net depreciated purchase price to obtain a one cent per-mile reduction in fuel costs. Assuming, for example, that a vehicle depreciates 20 percent in the first year, a household should be willing to buy a vehicle offering a one cent improvement in fuel economy for up to $750 increment in initial

TABLE 5-1. MARGINAL RATES OF SUBSTITUTION: ONE-VEHICLE TYPE CHOICE MODEL

FUEL COST VS. PURCHASE PRICE

	$ Price Premium to Acquire Additional 1¢/Mile Fuel Economy			
	Low Education		High Education	
	Low Income	High Income	Low Income	High Income
Urban[4]	578	569	951	1682
Rural[4]	185	-641	563	528

EXCESS SEATS VS. PURCHASE PRICE[1]

	$ Price Premium to Acquire Excess Seats			
	One Excess Seat		Two Excess Seats	
	Low Ed.[3]	High Ed.[3]	Low Ed.	High Ed.
Low Income[2]	1880	1850	645	634
High Income[2]	5790	5520	1985	1893

LUGGAGE SPACE VS. PURCHASE PRICE

	$ Price Premium to Acquire 1 Ft^3 Additional Luggage Space			
	HH SIZE < 4		HH Size ≥ 4	
	Low Ed.	High Ed.	Low Ed.	High Ed.
Low Income	45	44	78	76
High Income	138	131	238	226

TABLE 5-1. MARGINAL RATES OF SUBSTITUTION: ONE-VEHICLE TYPE CHOICE MODEL (Con't)

4. VEHICLE WEIGHT VS. NET PURCHASE PRICE

$ Price Premium to Acquire Additional 100 lbs		
Age of Head	Low Income	Hi Income
< 30	-7	-23
30-45	59	176
> 45	132	396

5. VEHICLE WEIGHT VS. FUEL COST

Cents/Mile Given Up to Acquire Additional 100 lbs					
		Low Education		High Education	
	Age	Low Income	High Income	Low Income	High Income
Urban HH	< 30	- 0.013	-.042	-.008	-.013
	30-45	.10	.33	.062	.10
	> 45	.22	.74	.14	.24
Rural HH	30	-.042	.037	-.013	-.04
	30-45	.34	-.289	.105	.334
	45	.73	-.65	.235	.749

Notes

[1]Excess seats are defined as:
(# adults + .6*# children (<16))-((front + rear shoulder room)/25")
where the first term represents household seating needs and the second term represents vehicle seating capacity assuming 25" shoulder room per seat.

[2]Low income households are those with incomes below what the BLS has defined as the budget to support a medium standard of living adjusted for region, city size, and household size.

[3]Low education households are those where the household head did not attend college.

[4]Urban households are those residing within the boundaries of an SMSA.

TABLE 5-2. MARGINAL RATES OF SUBSTITUTION: FUEL COSTS VS. PURCHASE PRICE

	Price Premium Willing to Pay to Acquire Additional 1¢/mile Fuel Economy (Dollars)	Net Depreciated Purchase Price Premium (Dollars)	First Year Fuel Cost Savings (Dollars)	Excess Premium Over Fuel Savings
HE, HI, U	1682	336	150	186
HE, LI, U	951	190	150	40
LE, LI, U	578	116	150	-34
LE, HI, U	569	114	150	-36
HE, LI, R	563	113	150	-37
HE, HI, R	528	106	150	-44
LE, LI, R	185	37	150	-113
LE, HI, R	-641	NA	150	NA

Notes:

LE = Low Education
HE = High Education
LI = Low Income
HI = High Income
U = Urban
R = Rural

purchase price.* As can be seen from Table 5-2, high-education, high-income, urban households appear to be willing to spend an additional $1682 in initial purchase price, or, in other words $336 in net depreciated purchase price, to achieve a fuel economy improvement which will only save them $150. High-education, low-income, urban households would be willing to spend $190 in net depreciated purchase price premium for this same reduction in fuel costs. On the other hand, the two low-education, urban groups and the two high-education, rural groups seem willing to spend somewhat less in net depreciated purchase price premiums than what they would save in reduced fuel costs. These groups shortfalls range from $34 to $44. The low-education, low-income rural group seems willing to spend only an additional $37 in net depreciated purchase price to achieve a $150 fuel cost reduction. Finally, the low-education, high-income, rural group exhibits an anomalous aversion to fuel cost savings. The implied marginal rate of substitution of -$641 indicates that this group would have to be paid to accept fuel cost savings. CSI hypothesizes that this result is accounted for by the fact that, relative to their urban counterparts, these households generally get better gas mileage (for any given vehicle) and face lower fuel prices.

These data indicate that different household groups handle the two vehicle cost components, acquisition and operating costs, in different ways. High education, high-income, urban households are much more concerned with future costs. Low-education, low-income, rural households show a much greater concern for present costs. These findings suggest that no statement of the "rationality" of a household's revealed preferences is valid without taking account of differential discount rates between future and present costs

*This assumes the vehicle is traded in after one year. If, for example, a vehicle is held for two years, depreciating 35 percent over that time, a rational household should be willing to pay up to $817 in additional purchase cost to save $286 in discounted operating cost over the two-year span. This analysis assumes that the depreciation rate for the cost increment spent to obtain higher fuel economy is the same as for the car as a whole, and that the household discounts future operating costs at 10 percent.

among different household groupings. In addition, in judging the "rationality" of households revealed tradeoffs between initial purchase price and operating costs, it should be noted that the model takes no account of consumers who base current choices on future expectations of fuel prices. If, for example, a consumer expects fuel prices to increase sharply over the intended life of the vehicle, the model would indicate a willingness to spend more "up front" in acquiring the vehicle than could be saved in operating costs at current fuel prices. This probably accounts for the high-education, high-income, urban households' willingness to pay more for fuel economy than they would expect to recoup at current fuel prices.

Moving on to the other implied marginal rates of substitution, it is apparent from Table 5-1 that adequate seating capacity is a crucial determinant of choice in that households will pay dearly to avoid having a vehicle seating significantly less than the desired number of passengers. Luggage space, too, appears to be an important consideration, with large, high-income households apparently willing to pay almost $600 extra in initial purchase price to obtain additional luggage space equivalent to a standard "two-suiter" suitcase. (A standard "two-suiter" suitcase has a volume of 2.5 cubic feet.) Smaller households, with less than four members, are clearly less concerned with trunk space.

The final two sets of marginal rates of substitution in Table 5-1 display the tradeoffs between vehicle weight and vehicle costs. In general, older, high income households express the greatest preference for vehicle weight. For example, Table 5-1 indicates that such households would be indifferent between two vehicles that, all else being equal, differed in weight by 300 pounds and in operating cost by 2.25 cents per mile. These differences are roughly equivalent to the changes brought about by "downsizing" of full-sized cars introduced in the 1977 model year fleet. The results would suggest that all strata would prefer the downsized versions of the full-sized cars, at least with respect to the weight and operating cost attributes.

As a final point on the cost coefficients, it should be noted that the transaction cost coefficient is extremely high (three to ten times) relative to the values of the vehicle attribute coefficients (e.g., fuel economy, seating capacity, etc.). This implies that, in the short term, there is signifcant inertia favoring maintaining existing holdings. Even assuming that new vehicles might offer significant improvements in fuel economy, seating capacity and other vehicle attributes, the empirical results suggest that most consumers would favor holding onto their existing vehicle for the next year. Over time, of course, the utility of maintaining current holdings declines as the household's vehicle ages and its reliability deteriorates.

5.2 GENERAL ORDINAL RANKINGS OF VARIOUS ATTRIBUTES

5.2.1 Market Facts Consumer Experiments

Market Facts began with a portfolio of six vehicle attributes: vehicle size, interior room, acceleration, servicing frequency, gas consumption, and trunk space. Each of these attributes had several possible "levels." Each participant was presented with nine trade-off tasks, with each task consisting of comparing two of the six attributes. For each trade-off task, participants were given a set of cards on which were described one level of each of the two attributes. For example, if the trade-off were between interior room (large, average, small) and trunk space (large, average, small), the participant saw nine cards. The participant laid the cards out on a table according to a numbering system forming a matrix. Then, the participant rank-ordered the cards by placing each card in an envelope that corresponded to a specific point on a preference scale, with the number of points on the scale dependent upon the number of cells in the matrix. In this manner, each attribute could be either directly or indirectly compared to all other attributes.

Market Facts then analyzed these preference data with the aid of a computer program to transform them into numerical "utilities."

A number of these "utilities" are reported by Market Facts; only general, non-numerical results are reported here.

Among all classes of vehicles, gas consumption and servicing are the most important attributes. These were roughly five times as important as the least important vehicle attribute, trunk space. With respect to vehicle size, consumers appeared to value mid-sized cars the most. Table 5-3 summarizes the relative importance of each attribute for each subgroup.

There was little distinction among the six vehicle class groups in terms of the relative importance with which they related each attribute. The exception was vehicle size. Among owners of mini/subcompact cars, vehicle size was the least valued attribute. This was not the case for other consumer subgroups. Moreover, these utility data reveal a "shift" in preference toward mid-sized vehicles occurring at both ends of the vehicle class continuum. When faced with attribute trade-off decisions, owners of mid-sized vehicles and light trucks expressed a preference for mid-sized vehicles as did owners of smaller vehicles. Owners of full-sized cars showed little distinction in their preferences between a full-sized and mid-sized car. Hence, mid-sized cars have substantial appeal to drivers of full-sized models.

5.2.2 National Transportation Survey (NTS) Results

The NTS survey considered the following nine attributes:

- fuel economy
- purchase price
- reliability
- handling
- safety
- interior roominess
- luggage and load carrying capacity

TABLE 5-3. MARKET FACTS RANKING OF VEHICLE ATTRIBUTES BY VEHICLE TYPE

	VEHICLE CLASS					
Rank Order Of Attribute Importance	Mini/Sub-compact	Compact	Mid-Size	Full-Size	Pickup Trucks	Van/ Utility Trucks
1	Gas Consumption	Gas Consumption	Gas Consumption	Gas Consumption	Gas Consumption	Servicing
2	Servicing	Servicing	Servicing	Servicing	Servicing	Gas Consumption
3	Acceleration	Acceleration	Size(Midsize)	Size(Midsize)	Acceleration	Acceleration
4	Trunk Space	Size(Midsize)	Acceleration	Acceleration	Size(Fullsize, Midsize)	Size(Midsize, Fullsize)
5	Interior Room	Interior Room	Interior Room	Interior Room	Interior Room	Interior Room
6	Size(Compact, Midsize)	Truck Space	Truck Space	Truck Space	Truck Space	Truck Space

Source: Market Facts, Inc., A Study of Consumer Behavior Towards Fuel Efficient Vehicles. Prepared for NHTSA: Interim Report, June 1979.

- o styling
- o comfort.

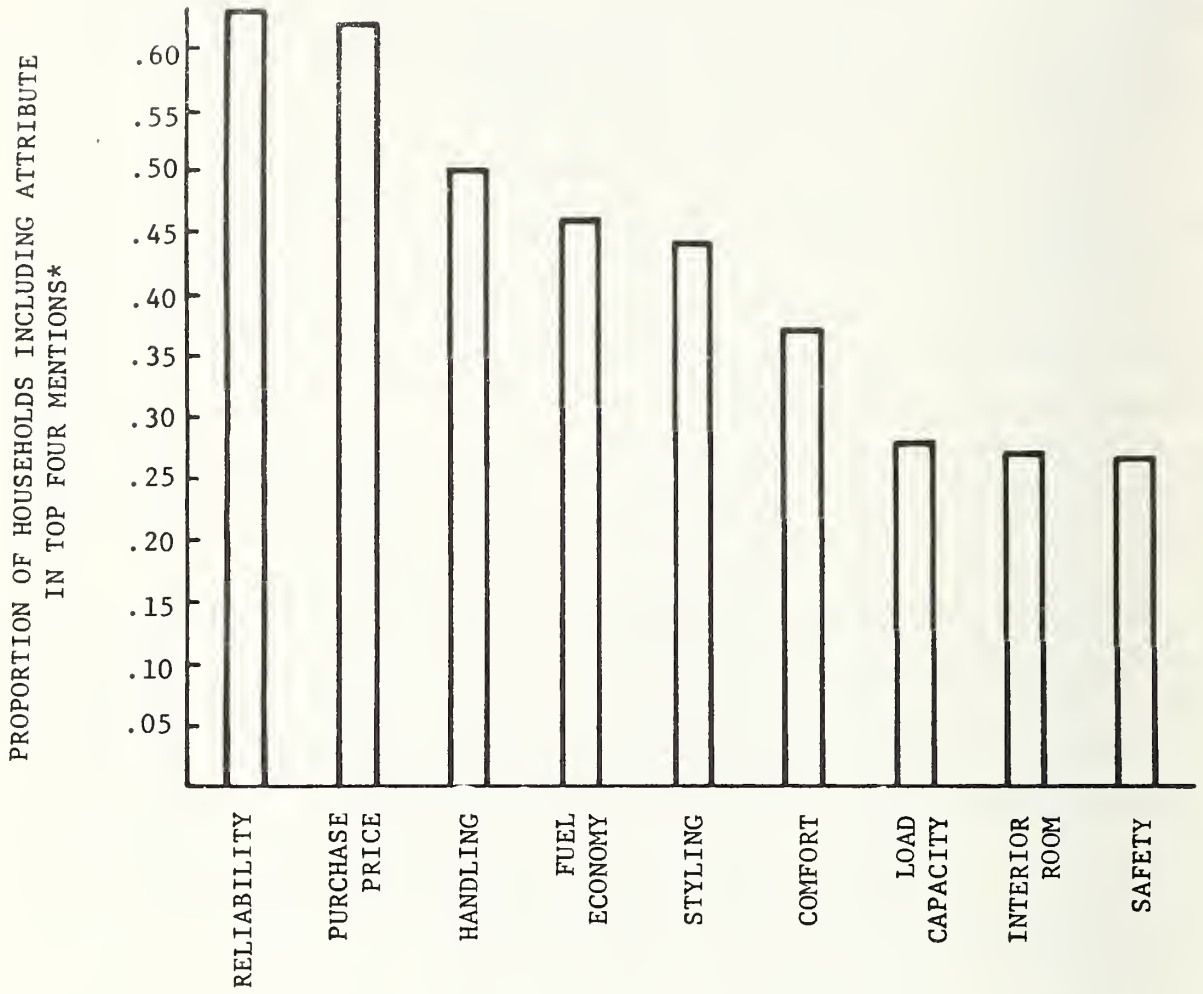
For each vehicle owned by a household, the household head was asked to select and rank, in order of importance, which four of the nine attributes were most influential in determining the specific choice of vehicle make and model.

It should be stressed that respondents were asked to give their current impressions of the criteria dictating their choice at the time of purchase. For vehicles purchased several years ago, it is somewhat unclear as to what extent consumers can reliably reconstruct their original choice process. Thus, it can be expected that fuel economy will show up as an important vehicle type choice attribute, more as a result of current consumer pre-occupation with energy conservation than as a true reflection of consumer sentiment at the time of vehicle purchase.

Figure 5-1 displays the relative frequency with which each vehicle attribute was mentioned as one of the four most important criteria influencing NTS households' vehicle purchase decisions. The attributes are presented in decreasing order of importance, without consideration of the rank of the characteristic among the top four. For example, a first place ranking for purchase price was counted as equivalent to a fourth place ranking for comfort in constructing the frequency distribution.

As shown, reliability was the attribute most often mentioned followed by purchase price, handling, gas economy, styling, comfort, luggage carrying capacity, interior room, and finally, safety. These results do not necessarily imply that safety is not important to vehicle owners, but only that most vehicles are perceived to have relatively comparable safety performance. Thus, safety considerations are not as strong (as price for example) in discriminating between vehicle type, particularly those in the same size class.

It is interesting to note that two of the components of the cost of owning and operating a vehicle -- purchase price and



* Proportions do not sum to one since households gave an average of 3.83 attribute mentions per vehicle.

Source: NTS Survey of 1978.

FIGURE 5-1. FREQUENCY OF ANY MENTION OF VEHICLE PURCHASE CRITERIA

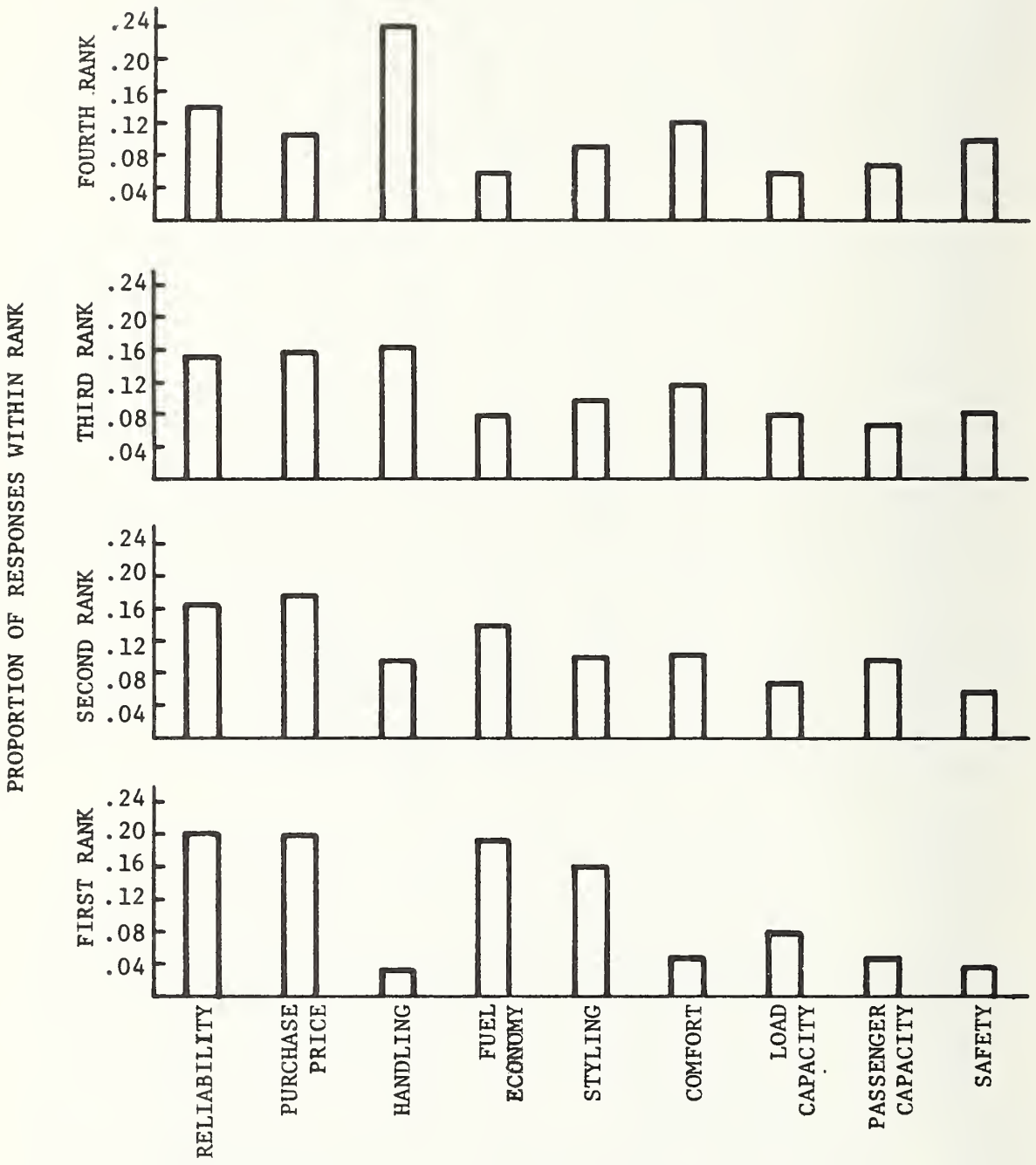
reliability -- are the most important determinants of vehicle choice, while the third -- fuel economy -- plays a relatively less important role, falling lower than handling in the overall ranking. This partially reflects the fact that fuel costs comprise only a relatively small fraction of the overall costs of owning and operating a car. It also should be noted that about a quarter of the current household vehicle fleet was acquired prior to the 1973 oil boycott in a period when fuel economy was not of paramount concern.

As for the relative importance of reliability, this attribute impacts more than operating costs, also reflecting the level of inconvenience an owner is likely to experience in lost vehicle availability and in time spent travelling to repair facilities.

The measures of vehicle capacity, both passenger and cargo, were mentioned surprisingly infrequently as a factor influencing vehicle type choice. This stands in direct contrast to consumers' revealed preferences examined in the empirical model of household vehicle type choice behavior described in Section 5.1.

The above results disregard relative rankings in constructing the frequency distribution of consumer responses. A somewhat different pattern of consumer preferences emerges when responses are examined according to their rank order.

Although fuel economy was mentioned by only 46 percent of the NTS households as being one of the four most important factors in their vehicle purchase decision compared with 63 percent mentioning reliability and 61 percent handling, Figure 5-2 shows that it was just as frequently mentioned as the most important attribute as the other two cost-related factors (purchase price and reliability). Collectively, approximately 60 percent of the households mentioned price, fuel economy, or reliability as being of primary importance. However, if fuel economy were not mentioned as one of the most important attributes by a household, it was likely not to be mentioned at all. Purchase price and reliability, on the other hand, continued to be relatively strong attributes as third



Source: NTS Survey of 1978.

FIGURE 5-2. RELATIVE RANKING OF VEHICLE PURCHASE ATTRIBUTES

or fourth-level influences in the vehicle purchase decision. This explains the relatively low overall ranking of fuel economy observed in Figure 5-1.

Certain attributes, although important, were definitely secondary considerations in the vehicle purchase decision. Vehicle handling is the most striking example of a secondary attribute. Its high rank (third) in overall frequency of any mention is primarily due to the likelihood that a household would mention it as a third or fourth consideration in the vehicle choice decision. Over 40 percent ranked handling as either third or fourth in importance, while only three percent mentioned it as the primary determinant of vehicle choice. Safety and comfort also were more likely to be mentioned as secondary or tertiary influences, although to a lesser degree than handling.

6. MAJOR MOTOR VEHICLE OWNERSHIP TRENDS

This section discusses the two most striking trends of the 1970's: the growth in total motor vehicle ownership, and the growth in increased personal use of light trucks.

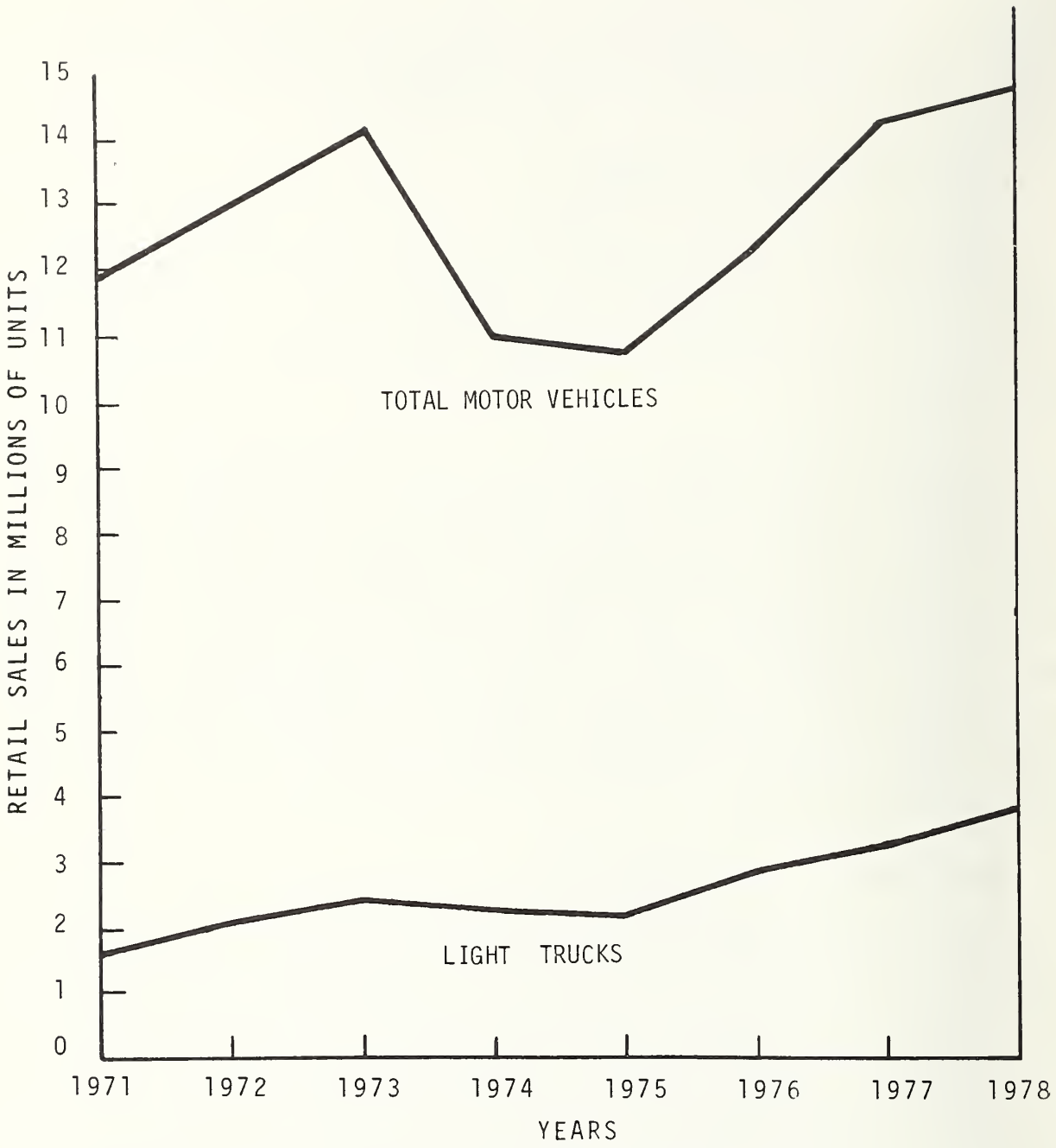
6.1 TOTAL MOTOR VEHICLE GROWTH

Motor vehicle sales increased at a 3.1 percent annual rate during the 1970's (Figure 6-1), accompanied by a 4 percent annual growth rate for the registered fleet (Table 6-1). These growth rates exceed those of any of the major demographic variables shown in Table 6-2.

The trend for the motor vehicle fleet to outperform the major demographic variables has continued unabated since 1946. Thus, the American life style of the 1970's continued to encourage greater use of private motor vehicle transportation, as it has for more than three decades. The Arab Oil Embargo of 1973-74 did not impact this long term trend in motor vehicle ownership. The 1979-80 gasoline price rises may have halted this long term trend, but to date (June 1980) the evidence is too spotty to warrant such a definitive conclusion.

6.2 MOTOR VEHICLES PER HOUSEHOLD

Motor vehicle ownership on a per household basis increased throughout the 1970's. The percent of households owning no motor vehicles declined by only 4 percentage points, from 18 percent to 14 percent, during the decade. Therefore, the increase in per household motor vehicle growth was primarily due to sharp increases in multi-vehicle households. Average household size and the mean number of adults per household both declined slightly during the 1970's. This fact, combined with the total motor vehicle growth, indicates that the number and percent of adults who have a motor vehicle at their disposal increased dramatically during the past decade. Motor vehicles per adult household member increased by 21 percent (Table 6-3).



SOURCE: TSC ANALYSIS OF MVMA AND WARD'S DATA

FIGURE 6-1. NEW MOTOR VEHICLE SALES, BY YEAR

TABLE 6-1. MOTOR VEHICLES IN OPERATION

YEAR	CARS (IN MILLIONS)	% GROWTH	TRUCKS (IN MILLIONS)	% GROWTH	TOTAL (IN MILLIONS)	% GROWTH
1965	68.9	4.3	13.1	5.6	82.0	4.6
1966	71.3	3.5	14.4	9.9	85.7	4.5
1967	73.0	2.3	15.0	4.1	88.0	2.6
1968	75.4	3.3	15.7	4.1	91.1	3.5
1969	78.5	4.1	16.6	4.6	95.1	4.3
1970	80.4	2.4	17.7	5.7	98.1	3.1
1971	83.1	3.4	18.5	6.6	101.6	3.5
1972	86.4	4.0	19.8	4.5	106.2	4.5
1973	89.8	4.0	21.4	7.0	110.2	3.7
1974	92.6	3.1	23.3	8.0	115.9	5.1
1975	95.2	2.8	24.8	8.8	120.0	3.5
1976	97.8	2.7	26.6	6.4	124.4	3.6
1977	99.9	2.1	28.2	7.2	128.1	2.9
1978	103.0	3.1	30.5	6.0	133.5	4.2

Note: **Trucks includes all trucks and buses. TSC estimates that over 85% of all registered trucks and buses are light trucks.**

Source: R.L. Polk and Company.

TABLE 6-2. GROWTH IN MAJOR DEMOGRAPHIC VARIABLES DURING 1970's VS. GROWTH IN MOTOR VEHICLE SALES AND REGISTRATIONS

Variable	1970-77 Annual Growth Rate
Motor Vehicle Sales	3.1
Registered Fleet Size	4.0
Population	0.9
Population of Driving Age	1.8
Household Formation	2.3
Per Capita Disposable Personal Income (constant dollars)	2.5

Source: U.S. Bureau of the Census, Statistical Abstract of the United States - 1978. Washington, DC, 1978, pp. 29, 43, 442.

TABLE 6-3. MOTOR VEHICLES PER HOUSEHOLD

	1970[a]	1975[b]	1976[b]	1977[a]	1978[c]
Cars	1.15	1.18	1.18	1.20	N/A
Trucks	.23	.21	.22	.28	N/A
Total Motor Vehicles Per Household	1.38	1.39	1.40	1.48	1.61
Households with no Motor Vehicles	18%	15%(*)	15%(*)	17%	14%
Average Population Per Household(d)	3.14	2.94	2.89	2.86	2.81
18 and over Population Per Household	2.05	2.01	2.00	1.99	1.98

(*) Households without cars, some of these households may own trucks.

Sources:
a. University of Michigan, Survey of Consumer Finances, 1970, 1977.
b. U.S. Annual Housing Survey, 1975, 1976.
c. NSF/National Transportation Survey, 1978. The survey lists only total ownership by household.
d. U.S. Census, Current Population Report. P-20, No. 327, August 1978.

Multi-vehicle household ownership grew fastest in the 1970's where it was the weakest. For example, University of Michigan data show that multi-vehicle ownership in the central cities of the 12 largest metropolitan areas grew from 17 percent in 1970 to 34 percent in 1977.[1] Meanwhile in the suburban areas, where traditionally more households own two or more vehicles, the growth was only from 34 percent to 47 percent. These growth patterns have stabilized motor vehicle ownership throughout the nation. As Table 6-4 and Figure 6-2 indicate, the Census divisions with the fastest population growth have about the same motor vehicle ownership rates as the country as a whole.

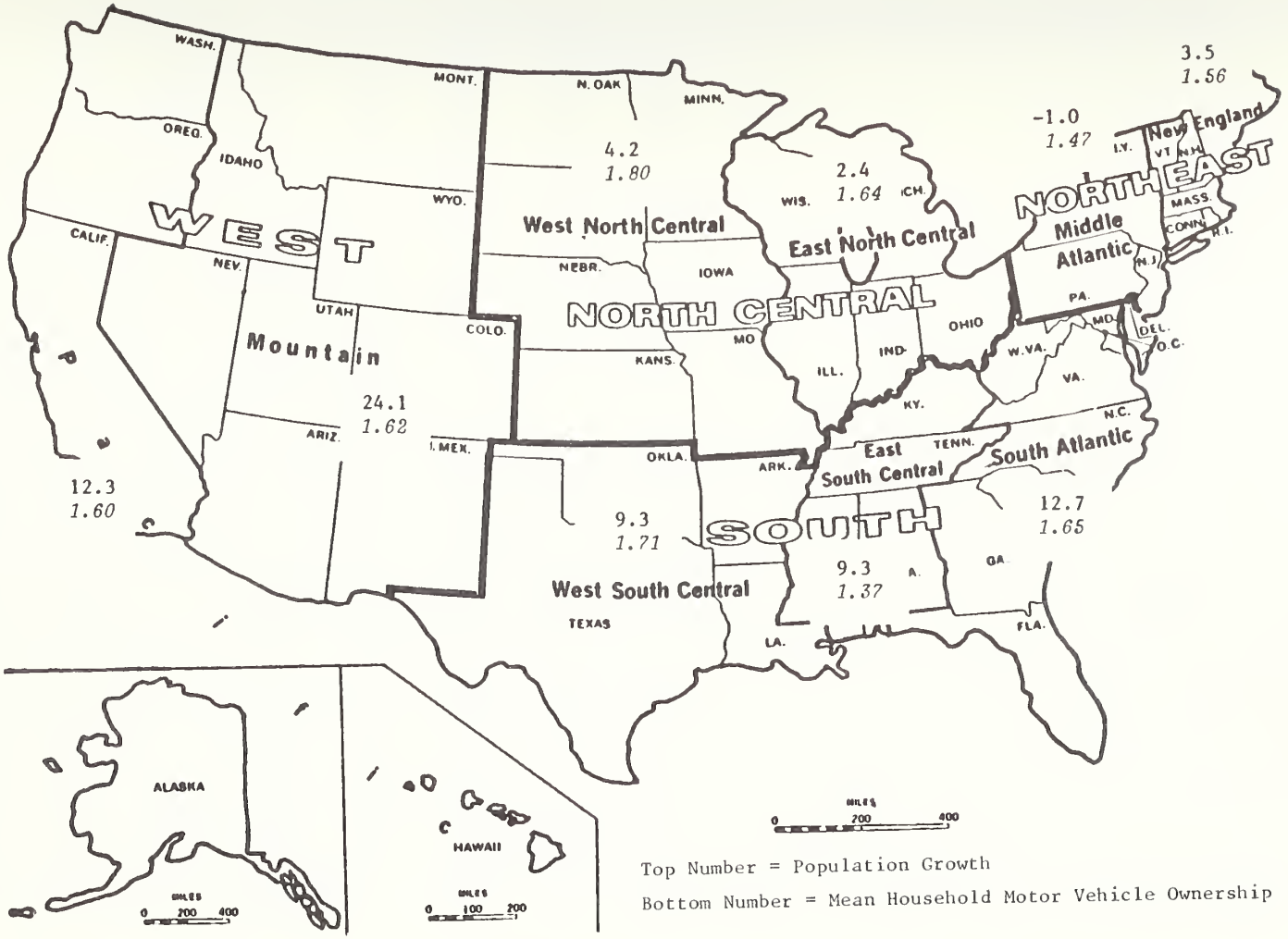
6.3 LIGHT TRUCK GROWTH AND USAGE

The large growth in light truck ownership has already been documented (see Part II, Section 5.6). This section seeks to more clearly emphasize the demographics identifying the light truck owner and the changing use of the vehicle.

During the 1970's, many more people entered the light truck market. Although light truck ownership had traditionally been concentrated among farm workers and self-employed businessmen who used their vehicles for job-related functions, trends in the past decade were toward white collar workers with more education becoming light truck owners.[2, 3]

Table 6-5 displays the increase in first-time light truck buyers, confirming that previously non-participating segments of society have entered the light truck market in increasing numbers. The fraction of buyers indicating that their light truck purchase was their first increased by nearly 50 percent from 1977 to 1979.

During the 1970's, the light truck increasingly became a mode of personal transportation. Table 6-6 shows the percent of light truck buyers who plan to use their vehicles solely for personal transportation. The data are broken down between domestic light trucks and imported compact light trucks, clearly demonstrat-



SOURCE: U.S. Census Current Population Report, P-25-79D, Dec. 1978
CSI/WESTAT, Inc., Motor Vehicle Assessment, Vol. 1, Table 5-4.

FIGURE 6-2. POPULATION GROWTH (1970-1978) AND MEAN HOUSEHOLD MOTOR VEHICLE OWNERSHIP (1978) BY CENSUS DIVISION

TABLE 6-4. POPULATION GROWTH AND MEAN HOUSEHOLD MOTOR VEHICLE OWNERSHIP

CENSUS DIVISIONS	POPULATION GROWTH[a] 1970 - 1978	MEAN HOUSEHOLD[b] MOTOR VEHICLE OWNERSHIP
Mountain	24.1	1.62
South Atlantic	12.7	1.65
Pacific	12.3	1.60
West South Central	9.3	1.71
East South Central	9.3	1.37
West North Central	4.2	1.80
New England	3.5	1.56
East North Central	2.4	1.64
Mid-Atlantic	-1.0	1.47
Avg. U.S.	7.3	1.61

Sources: a. U.S. Census, Current Population Report, P-25-790, December 1978.

b. CSI/Westat, Inc., Motor Vehicle Assessment, Vol. 1, Table 5.4.

TABLE 6-5. INCREASE IN FIRST TIME LIGHT TRUCK BUYERS

Percent of Light Truck Buyers Who Indicated That Their Light Truck Purchase Was Their First	
1977	15.7
1978	20.0
1979	22.6

TABLE 6-6. PERCENT OF LIGHT TRUCK BUYERS WHO PLAN TO USE THEIR VEHICLE SOLELY FOR PERSONAL TRANSPORTATION

	Standard Sized (Domestics)	Compacts (Imports)
1977	26.7	28.9
1978	41.2	53.0
1979	48.9	58.0
Net Change, 1977-1979	83	101

Source: Data derived from Rogers National Research, Inc. Profiles of Model Years 1977, 1978, 1979 Light Truck Buyers.

ing that the trend is more pronounced among the buyers of smaller light trucks. The fraction of domestic make light truck buyers planning to use their vehicles solely for personal transportation increased by 83 percent; the comparable increase for compact light truck buyers was 101 percent.

Economic considerations within the household may have been one factor in this move toward the light truck as a mode of personal transportation. As Part II, Section 5 showed, at low annual mileage the cost of operating a light truck is less than the cost of operating a full-sized car. Furthermore, it appears that the lower income vehicle buyer who desires the overall size and roominess afforded by a full-sized car has in many cases purchased a pickup truck as an alternative to the more expensive (initial cost) full-sized passenger car.*

Table 6-7 displays the median household income of 1979 light truck buyers and low-price full-sized car buyers. The median incomes of these market segments are clustered into three groups. Passenger van owners had the highest income, at slightly more than $26,000. Owners of utility vehicles and low-price full-sized cars had a median household income of roughly $23,850. Pickup truck and van owners had a median household income of about $21,400, with compact pickup truck owners close behind at approximately $20,800. All of these income data, however, are well above the U.S. national median household income of $16,750. Hence, only those households that were significantly more affluent than the national median household purchased new light trucks and full-sized cars in 1979.

Table 6-7 also shows the degree to which expected fuel economy influenced the purchase of each vehicle-type. Owners of every vehicle-type, with the exception of compact pickup truck owners, overwhelmingly stated that expected fuel economy did not have an effect on the vehicle purchase decision. About three-fourths of the compact pickup truck owners indicated that expected fuel

*For comparative costs of full-sized car and pickup truck see Part II, Section 5.4.

TABLE 6-7. BUYERS OF 1979 LIGHT TRUCKS AND LOW-PRICE FULL-SIZED CARS BY INCOME AND FUEL ECONOMY AS A PURCHASE CONSIDERATION

	Median Household Income (Dollars)	Effect of Expected Fuel Economy On Purchase Decision (Percents)		
		Yes	No	Total
Pickup Trucks	21,331	28.8	71.2	100.0
Vans	21,461	26.1	73.9	100.0
Passenger Vans	26,221	18.4	81.6	100.0
Utilities	23,876	18.4	81.6	100.0
Compact Pickup Trucks	20,781	72.6	27.4	100.0
Low-price Full-sized Cars	23,830	24.3	75.7	100.0
TOTAL U.S.	16,750*			

Source: Data derived from Rogers National Research, Inc. Profiles of Model Year 1979 Light Truck and Car Buyers.

*Estimated from Census data.

economy was a salient purchase criterion. However, this is probably related to the fact that compact pickups are widely known to get much better fuel mileage, as well as the fact that these buyers had the lowest median income and could be expected to be mroe concerned with fuel economy than the wealthier light truck and full-sized car buyers.

Table 6-8 shows the occupation distribution of light truck and full-sized car owners and the corresponding national data. Professional/technical persons owned, relative to their total population representation, a much higher proportion of passenger vans and a significantly lower percentage of pickup trucks. Their ownerships of vans, utility vehicles, compact pickup trucks, and low-price full-sized cars was at a rate approximately equal to their representation in the U.S. population.

Skilled trade/proprietor persons owned low-price full-sized cars at a lower rate than their population representation. However, their ownership level of all other vehicle groups was considerably higher than their representation in the U.S. population.

Farmers owned pickup trucks at a rate more than four times the level of their population representation. In addition, their compact pickup truck ownership exceeded their population representation by 50 percent. Both of these results are probably due to work-related vehicle use. On the other hand, farmers owned vans at a rate only one-third as great as their population representation. This indicates that among farmers vans are not considered to be substitutes for pickups. For every other vehicle-type, farmers owned vehicles at a rate roughly commensurate to their population representation.

Table 6-9 gives the distribution of owner's area of residence by vehicle-type. For every vehicle-type, city/suburb dwellers owned vehicles at a lower rate than their population representation. This was most pronounced among pickup trucks, and least pronounced among vans. Conversely, rural/farming residents owned every vehicle-type at a higher rate than their representation in the general population.

TABLE 6-8. BUYERS OF 1979 LIGHT TRUCKS AND LOW-PRICE FULL-SIZED CARS BY OCCUPATION (PERCENTS)

	Professional/ Technical	Skilled Trade/ Proprietor	Farmer	Other	Total
Pickup Trucks	8.7	26.7	13.7	50.9	100.0
Vans	14.4	33.7	1.0	50.9	100.0
Passenger Vans	23.0	23.0	2.3	51.7	100.0
Utilities	18.0	22.9	2.7	56.4	100.0
Compact Pickup Trucks	15.7	26.3	4.5	53.5	100.0
Low-price Full-sized Cars	13.4	10.6	3.4	72.6	100.0
TOTAL U.S.*	15.1	15.1	3.0	66.8	100.0

Source: Data derived from Rogers National Research, Inc. Profiles Model Year 1979 Light Truck and Car Buyers.

*U.S. Dept. of Commerce, Bureau of the Census, Statistical Abstract of the United States, 1979, pp. 416-418.

TABLE 6-9. BUYERS OF 1979 LIGHT TRUCKS AND LOW-PRICE FULL-SIZED CARS BY AREA OF RESIDENCE
(Percent)

	City/Suburb	Rural/Farming	Total
Pickup Trucks	37.3	62.7	100.0
Vans	64.3	35.7	100.0
Passenger Vans	57.0	43.0	100.0
Utilities	44.8	55.2	100.0
Compact Pickup Trucks	49.6	50.4	100.0
Low-price Full-Sized Cars	52.8	47.2	100.0
TOTAL U.S.*	67.0	33.0	100.0

Source: Data derived from Rogers National Research, Inc. Profiles of Model Year 1979 Light Truck and Car Buyers.

*U.S. Dept. of Commerce, Bureau of the Census, Statistical Abstract of the United States, 1979, p. 17.

6.4 REFERENCES FOR SECTION 6

1. University of Michigan, 1977 Survey of Consumer Finances, Motor Vehicle Tabulations, Tables D-5 and D-5a.

2. University of Michigan, Survey of Consumer Sentiment, August 1978.

3. K.H. Schaeffer, et al., "Market Analysis and Consumer Impacts Source Document - Part II Review of Motor Vehicle Market and Consumer Expenditures on Motor Vehicle Transportation," U.S. Department of Transportation, Transportation Systems Center, Report No. DOT-TSC-NHTSA-80-2.II, Section 5.5, January 1980.

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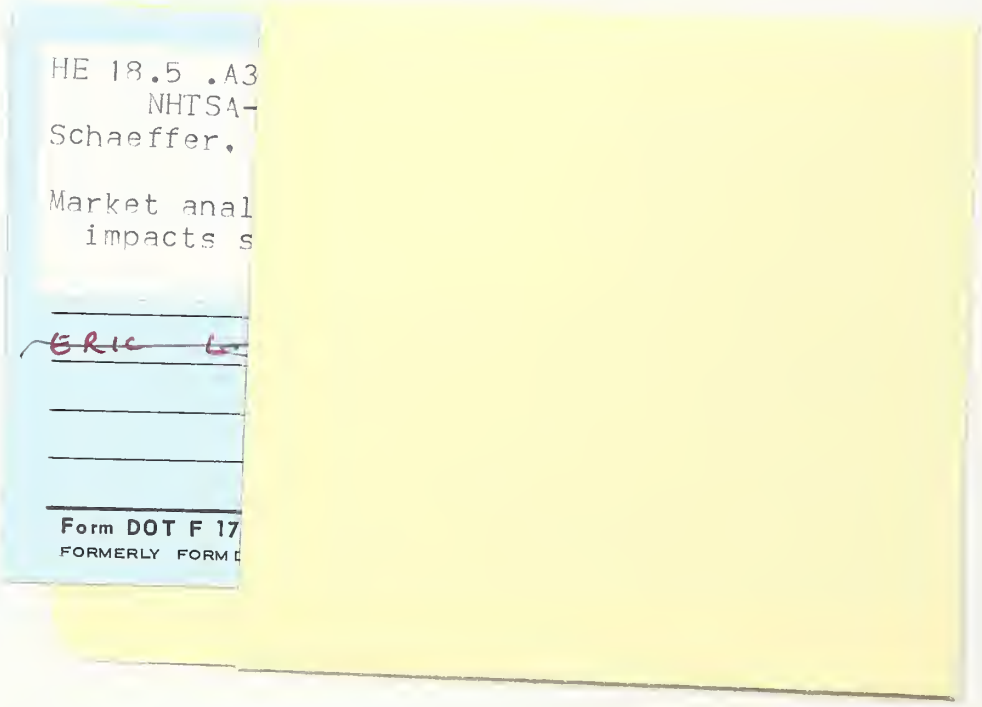
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